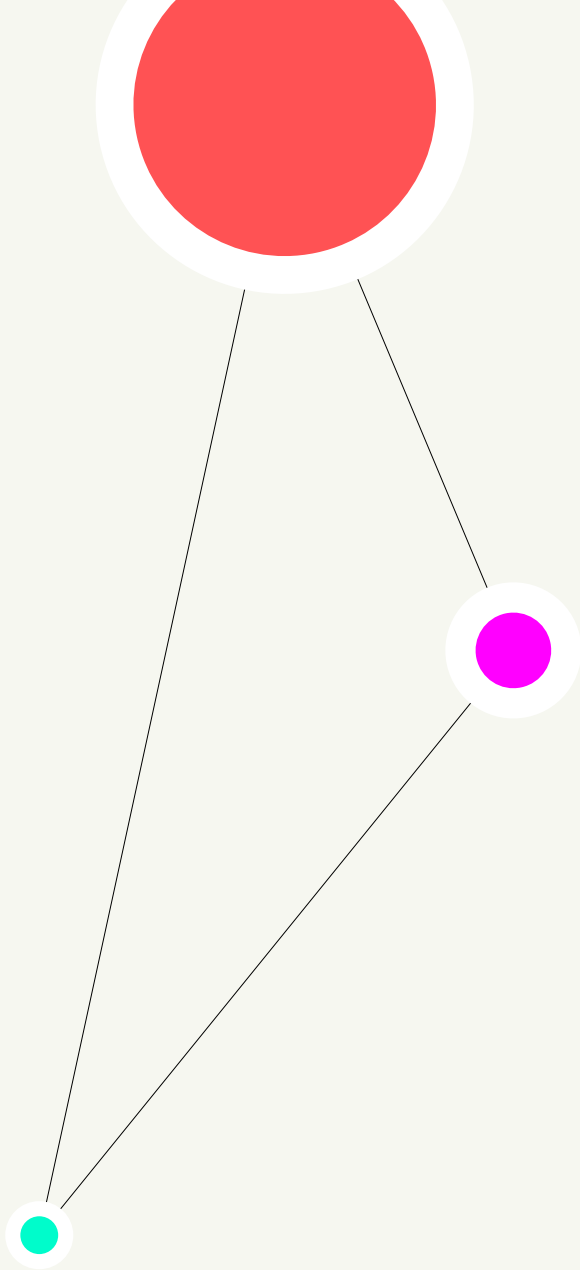
Tokyo Start-up Ecosystem



A global innovation leader
with large potential for start-up expansion

Tokyo Development Learning Center

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About Tokyo Development Learning Center (TDLC)
Launched in 2004 in partnership with the government of Japan, the Tokyo Development Learning Center (TDLC) is a pivotal World Bank program housed under the Global Practice for Urban, Disaster Risk Management, Resilience and Land (GPURL). Located in the heart of Tokyo, TDLC serves as a global knowledge hub that aims to operationalize Japanese and global urban development knowledge, insights, and technical expertise to maximize development impact. TDLC operates through four core activities: Technical Deep Dives (TDDs), Operational Support, Insights and Publications, and the City Partnership Program (CPP). For more information, visit www.worldbank.org/tdlc.

Authors and Acknowledgments

This research was developed by a team led by Victor Mulas (senior urban specialist) and composed of Pablo Astudillo (consultant), Takashi Riku (consultant), Jamil Wyne (consultant), and Xin Zhang (consultant). James Lee (consultant) and Koichi Ito (intern) also contributed to this research.

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Scope, Assumptions, and Key Concepts

This report analyzes the start-up ecosystem in Tokyo and the greater surrounding area in Japan. Start-up ecosystems have become critical to the country's innovation agenda and overall competitiveness. They can also enable the transformation of existing businesses, as well as the creation of new industries. Tokyo is the largest innovation hub in Japan, its most global city, and has the highest population and concentration of firms, universities, and other assets that are key to innovation (Dutta, Lanvin, and Wunsch-Vincent 2020; WIPO 2019). The country, and in particular the Greater Tokyo area, is globally recognized as a knowledge, technology, and innovation hub, and it is also home to more than 80 percent of venture capital investment and start-up funding in Japan (Dutta, Lanvin, and Wunsch-Vincent 2020; INITIAL 2021; Venture Enterprise Center 2020; WIPO 2019). For simplicity purposes, this report uses "the Greater Tokyo area" and "Tokyo" interchangeably, to refer to the Tokyo greater area start-up ecosystem.

Main assumption used in this report

The analysis of this report assumes that the innovation model is transitioning to a hybrid of traditional innovation research and development (R&D) model of public sector, corporations, and universities combined with start-up agile innovation (BCG 2019). This results in the merge of innovation and entrepreneurial ecosystems (particularly technology-led start-up ecosystems) transforming the nature of innovation ecosystems to innovation and start-up ecosystems (Autio et al. 2014). Following this assumption, we suggest that those innovation ecosystems that do not transform into hybrid innovation start-up ecosystems would become less dynamic and would lose competitiveness over time.

This transition to hybrid innovation start-up ecosystems is a global phenomenon, with start-up ecosystems emerging in major urban areas complementing innovation hubs. Along with San Francisco Bay area, and Boston, New York represents one of the most notable examples of the innovation start-up ecosystem model. New York is a major global innovation hub, ranking among the top 10 in the world (table 1.1). It is also the second largest start-up ecosystem in the United States and the third in the world (table 1.1). Different from San Francisco and Boston, the New York start-up ecosystem is more recent, having emerged after 2008. This fact, coupled with the urban characteristics of New York as a global city like Tokyo, makes New York a more relevant case for the analysis of the

Tokyo start-up ecosystem. For these reasons, the analysis of this report will leverage the New York City ecosystem as primary comparator. This comparative analysis is also complemented with data from other leading ecosystems.

For simplicity purposes, this report uses “New York” and “New York City”, and “San Francisco” and “San Francisco Bay area” interchangeably, to refer to the New York City and San Francisco Bay area ecosystems. For other ecosystems and science and technology clusters/hubs referred to in this report, we identify each ecosystem and cluster/hub by the largest city within their metropolitan area.

Key concepts used in this report

Science and Technology Cluster or Hub: In this report we use the World Intellectual Property Organization (WIPO)’s definition of science and technology clusters or hubs, defined as a metropolitan area or conurbation with a high concentration of scientific knowledge and innovation outputs (for example, scientific publications and patents).

Start-up: For this report, we define start-ups as for-profit business ventures that (a) have a financial model that can achieve high growth and (b) employ an innovative and technology-enabled approach to the product or service that they provide to ensure scalability. These ventures may or may not be profitable at the current stage (Mulas et al. 2018).

Start-up Ecosystem: Although there is no single, widely agreed-upon definition of start-up or entrepreneurial ecosystem, the most common definition refers to a system with a series of complex relationships that are formed between actors or entities whose functional goal is to enable business and technology development as well as innovation. These ecosystems are dynamic and self-regulatory (Isenberg 2014). The actors or entities within them include material resources (funds, equipment, facilities, and so forth) and human capital (students, faculty, staff, industry researchers, mentors, and so forth), which make up the institutional entities participating in the ecosystem (for example, the universities, business schools, research institutes, state or local economic development, funding agencies, and policy makers). See Jackson (2011). Social networks are a critical element of start-up ecosystems. They specifically support the identification of entrepreneurial opportunities (Drori, Ellis, and Shapira 2013); access to finance (Qian, Mulas, and Lerner 2018; Shane and Stuart 2002; Uzzi 1999); access to information (Coleman, Katz, and Menzel 1957); and the creation of resource effects and spillovers (Kalnins and Chung 2004; Stuart and Sorenson 2003), strategic alliances, and status signaling (Roberts and Sterling 2012; Stuart, Hoang, and Hybels 1999).

All dollar amounts are U.S. dollars unless otherwise indicated. For other terms, please refer to the Glossary at the end of the report.

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Scope and Objective

This report analyzes the start-up ecosystem in Tokyo and the greater surrounding area in Japan in the transition of the innovation model to a hybrid of traditional public sector-university-corporation research and development (R&D) combined with start-up agile innovation. It first introduces the role of a start-up ecosystem in contributing to the development of global cities, and thus to the wider national economy. It then takes a country-level view of Japan's innovation system, within which the metropolitan region operates, in the transition to the innovation-start-up ecosystem. This description is followed by an analysis of the specifics of the Tokyo start-up ecosystem — which consists of investment, support infrastructure, and skills infrastructure — factors that merit close inspection and deep analytics. And finally, the report ends with conclusions — what could be done better or differently to exploit opportunities within Tokyo — but also wider lessons for other global cities.

This report is intended to address a gap in the analysis of Tokyo's start-up ecosystem and its comparison with other leading global start-up ecosystems. Its main goals are to shine light into the opportunities to increase the ecosystem's performance and influence as a global innovation hub and to show the lessons learned from Tokyo's experience.

Global and domestic context

As economic transformation accelerates globally, knowledge, technology, and innovation have become the engines to generate productivity and forward-looking growth. In this transformation, start-ups have emerged as critical assets to create knowledge, innovation, and technology, and their rapid commercialization (BCG 2021). With the irruption in the past years of deep-technology start-ups in the rapid development of these advanced technologies (such as artificial intelligence, quantum computing, advanced materials, or biotechnology), innovation ecosystems have expanded and merged with start-up ecosystems. Corporations, universities, and R&D institutions rely heavily

in these new start-up actors for innovation and development of these new technologies. The recent case of the rapid development of messenger RNA technologies for COVID-19 vaccine is just a case of many others in this new dynamic (see box I.1).

Since its recovery from the Second World War, Japan has been a leader in technology and innovation. The country produced one of the most advanced innovation ecosystems globally, with major global innovation hubs, top science- and knowledge-producing universities, and a strong corporate sector investing considerably in R&D. Japan has one of the highest R&D intensity levels (R&D per gross domestic product [GDP]) in the world, producing some of the largest numbers of scientific publications and patents globally (OECD 2019). It is home to advanced universities and research centers, hosting several global leading science and technology clusters. Of the 100 leading clusters worldwide producing scientific publications and patents, Japan is home to 5 with Tokyo ranking first, and Osaka-Kobe-Kyoto and Nagoya are also among the top 15 in the world (Dutta, Lanvin, and Wunsch-Vincent 2020). Japanese corporations contribute significantly to the innovation system in the country. They are among the largest investors in R&D globally, with the third largest corporate R&D investment amount in the world (Grassano et al. 2020; Strategy& 2019).

However, Japan's traditional innovation ecosystem has not been paired with an equally robust and capable start-up ecosystem. Japan's start-up ecosystem is small for the size of the economy, is domestically oriented, and has produced limited results for the potential of the country. Japanese Venture Capital (VC) investment (which is the specialized risk investment in start-up growth) is a small part of global VC activity, with only 1.4 percentage of the global share. Japan has one of the lowest VC investment intensity levels — VC investment by GDP — with only 0.08 percent in 2019 as compared to 0.23 percent in China and 0.64 percent in the United States (see figure 1.3). Unlike other leading ecosystems, Japan is a net exporter of start-up investment, which suggests that the ecosystem does not have a critical mass of investment-ready opportunities for VC and corpora-

tions alike. Consequently, the ecosystem produces limited outputs, with 11 recorded as of January 2021. This number is lower than other large or high-income economies, including China, Germany, India, the United Kingdom, or the United States, as well as smaller economies, such as Israel or the Republic of Korea, all of which have long track records in intensive innovation (see figure 1.5).

The lack of a large and robust start-up ecosystem to support its traditional innovation system is starting to limit the production of innovation and technology outputs in Japan. If in 2010, 8 Japanese companies were recognized among the 15 most innovative companies in the world, by 2019 this number was reduced to only 2 (EconSight 2019). Similarly, whereas Japan was the global leader in patents granted in 2010, it has since been overcome by China, the United States, and the European Union (see figure 1.10). In fact, Japan is the only country of the top five largest patent generators that has registered negative growth for both patent applications and granted patents. The further development of Japan's start-up ecosystem to similar levels of peer countries would support the creation of a larger number of new technologies, markets, and firms. This is particularly relevant with the acceleration of technology-driven business models propelled by COVID-19 and its postrecovery dynamics.

Analysis of Japan's Start-up Ecosystem

Tokyo is the critical cluster to understand Japan's potential to develop a globally competitive start-up ecosystem at par with its highly advanced innovation system. Tokyo is the largest science and technology hub in Japan; is its most global city; and has the highest population and concentration of firms, universities, and other assets that are key to innovation. It also has the largest concentration of start-ups and Venture Capital (VC) investment in the country, representing 80 percent of start-up funding (INITIAL 2021).

To analyze the Tokyo start-up ecosystem, we employ a social network analysis enriched by comparative data analysis of supportive statistics form other leading start-up ecosystems. Start-up ecosys-

tems are essentially communities comprising a diverse range of organizations that support start-ups in myriad ways, enabling knowledge spillovers to occur and opening access to critical resources for entrepreneurs through a network of embedded connections. For simplicity purposes, the main elements of start-up ecosystems can be summarized as (a) community and social network, which comprises all formal and informal networks and connects all other elements of the ecosystem; (b) investment, which encompasses the funding resources available to entrepreneurs and stakeholders in the ecosystem; (c) support infrastructure, which refers to all the programs and resources available to entrepreneurs in an ecosystem to support their creation of start-ups; and (d) skills infrastructure, which includes all the available institutions that provide relevant skills in the ecosystem for entrepreneurs to create competitive ventures (see table 2.1).

Tokyo Start-up Ecosystem

Tokyo's start-up ecosystem is at an "advancing" stage, and it is not yet at par with its potential as the world's leading science and technology cluster and largest metropolitan area. Tokyo has notable assets that makes it competitive, for example, a substantial amount of investment activity, access to world-class universities, and corporate and government involvement. Yet, Tokyo still has lower overall VC investment levels and a smaller unicorn population compared with its economic potential and with other large global metropolitan areas with leading ecosystems.

Tokyo ecosystem is dominated by nonspecialized actors, limiting the ecosystem's growth orientation and international competitiveness. The ecosystem relies heavily on nonspecialized organizations, such as large domestic banks and financial institutions, who are not designed to cater to or understand the specific needs of growth-oriented start-ups and tend to have a more domestic mindset. The ecosystem's social network resembles that of traditional industries and differs significantly from leading start-up ecosystems (see figure 2.5). Whereas in Tokyo, 70 percent of the eco-

system relies in nonspecialized actors, in New York it is just 25 percent, with most of the ecosystem being formed and supported by specialized growth-oriented actors. Best performing ecosystems rely on a large community of specialized actors, who at their core are oriented to start-ups and who produce a critical mass of globally competitive start-ups. These specialized actors not only provide their expertise, knowledge, and funding to start-ups directly, but they also serve as connector hubs to access additional talent, knowledge, and networks of domestic and international mentors and funding that start-ups need as they grow. This disproportionate reliance on these nonspecialized actors suggests that Tokyo has not yet developed a sufficient population of specialized actors that operate with the sole purpose of helping tech entrepreneurs to start and grow companies to international competitive levels.

Tokyo's start-up ecosystem also has fewer international connections relative to other ecosystems and global start-up hubs. Tokyo has a limited number of international and global stakeholders oriented to start-ups. Only one global accelerator has a permanent presence in Tokyo (Plug and Play), and its local program is primarily affiliated with corporate sponsors (nonspecialized actors). Tokyo's ecosystem also attracts a limited amount of international investment. In 2020, only 11 percent of start-up funding in Tokyo came from foreign VCs, and since 2014, the highest amount has been 12 percent (INITIAL 2021). The ecosystem has one of the highest percentages of domestic funding with almost 50 percent of funding for unicorns coming from domestic investment. The ecosystem relies heavily on domestic investment and resources (for example, knowledge), increasing the bias toward domestic focus and limited growth. When analyzing deep-tech start-ups, Tokyo ecosystem's international connectivity is limited, highly dependent on San Francisco Bay area's ecosystem (the only ecosystem where it has a relevant connection through outbound investment), and is not part of any strong regional hub (see figure 2.6).

Tokyo investment in start-ups is not oriented for growth, and it is disproportionately concentrated in early stages. Specialized start-up growth funding (for example, VCs and angel investors) is relatively small in Tokyo, representing less than 25 percent of the overall start-up funding in the ecosystem (see figure 3.3). Additionally, overall funding is concentrated in early stages when compared with other ecosystems. Whereas globally, in the United States and Europe, VC investment is proportionality higher per stage, with more than 50 percent in later stages, in Japan the opposite is true with more than 60 percent in seed stage and less than 7 percent in later stage (see figure 3.4). This gap in late-stage funding poses a significant limitation for start-ups to scale and compete globally as they have to rely on more uncertain and slower mechanisms, such as public markets through early-stage IPO, than on specialized investment actors (such as VCs and angels) to access funding. Similarly, compared with other mature ecosystems the amount of funding for deals is much smaller. The average round for seed stage in Tokyo is about half of the global average, as well as the average levels in the United States and Europe (see figure 3.5).

The supporting infrastructure in Tokyo's ecosystem is highly domestic and underdeveloped. The ecosystem has very few specialized accelerator programs and home-grown experienced mentors and angel investors. Of the 155 accelerators and support programs included in this analysis, 75 percent were affiliated with corporations and public programs, whereas only 25 percent were specialized accelerators. Among the specialized accelerators, most are small and have few connections between one another. In contrast to that, most of New York's support programs operate independently of corporations and the government and have a central role in the ecosystem (see figure 4.1). There are no Tokyo accelerators on the 2019 Crunchbase top 100 accelerator list,[1] in comparison with numerous accelerators in the global leading ecosystems (for example, San Francisco, London, New York, and Singapore). The lack of a strong specialized support infrastructure in Tokyo limits founders' access to practical knowledge and networks (Aspen Network of Development

1 See https://about.crunchbase.com/blog/100-startup-accelerators-around-the-world/.

Entrepreneurs and Village Capital 2013; Aspen Network of Development Entrepreneurs, Agora Partnerships, I-DEV International 2014; and Roberts et al. 2016).

The ecosystem lacks a critical mass of experienced angels and mentors, a critical resource for start-up success. Mentors with start-up experience, together with specialized accelerator programs are necessary for start-ups to succeed and grow from the seed and early stages (Qian, Mulas, and Lerner 2018). However, mentor and angels are low in numbers, mostly domestic (with very few foreign ones) and have little influence in the ecosystem, operating in small subnetworks. Angel investment represented less than 2 percent of total funding received by start-ups in 2020, as compared with 18 percent in the United States (INITIAL 2021; Sohl 2020).

Tokyo's skills infrastructure is concentrated in universities with little presence of informal practical entrepreneurship programs. The most influential entities are the top three universities in Tokyo (the University of Tokyo, Keio University, and Waseda University), followed by Kyoto University and two corporate accelerators in Tokyo. Organizations providing new models of entrepreneurial and technical skills (such as coding boot camps, growth-oriented accelerators, and other training programs for rapid experiential skills) have a relatively small presence. The lack of a wider presence of these additional skills providers limits the ecosystem's ability to upgrade and tailor formal education for local talent through experiential learning — a critical need for start-up founders and employees to gain business, technology, and entrepreneurial skills.

Tokyo universities are expanding entrepreneurship education, but they still lack comprehensive university ecosystems to support the ecosystem's needs. In recent years, the three leading universities in Tokyo have been expanding practical entrepreneurial education together with a nascent practical entrepreneurial ecosystem for their student population. However, the most common programs in Japanese universities appear to be academic, teaching theory and frameworks that underpin the start-up journey rather than a program that offers students hands-on entrepreneur-

ship experience. Consequently, the number of start-ups, unicorns, and funds raised by the alumni of Tokyo-based universities is still relatively small (less than 200 per university) as compared with other leading large ecosystems, such as New York's (1,000–3,000 per university), or niche innovation ones, such as Tel Aviv's (600–1,500 per university) (see table 5.1).

Although still small, Japanese universities have developed strong R&D commercialization programs. Japanese universities have developed strong R&D commercialization programs, which include mentorship and talent matching for founders, as well as connections to accelerators and VC funds. There were more than 2,566 university-affiliated start-ups in Japan by 2018, and the number has been growing since 2014 (METI 2020). Funding raised by university-launched start-ups represented approximately 10 percent of start-up financing according to data reported in 2020 (INITIAL 2021). Although still small in numbers, these programs have started to link the traditional science and technology system with the start-up ecosystem.

Key Strengths and Opportunities

The Tokyo ecosystem has great potential for expanding into a leading global deep-tech hub, presenting a good example for countries that have invested in deep tech and advanced sciences. With high levels of public sector engagement and leadership to grow the ecosystem at the urban, regional, and national levels, Tokyo's ecosystem can evolve into a highly specialized global innovation hub, combining its strong national science and technology innovation system with its start-up ecosystem. The Tokyo ecosystem's key strengths are the following:

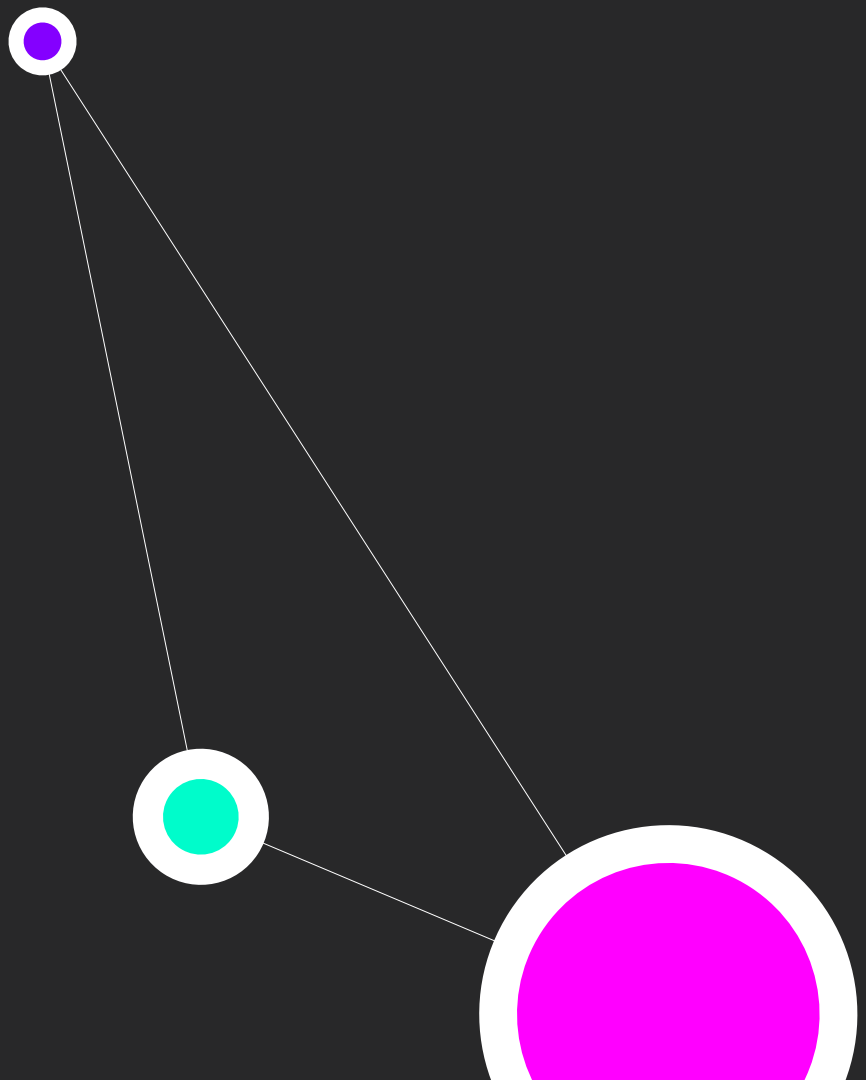
(a) The involvement of universities in the ecosystem and its robust commercialization programs
(b) The strong presence of corporations in the ecosystem with active corporate R&D commercialization programs

(c) The highly competitive deep-tech production with quality innovation and start-up outputs
(d) The strong potential government support for programs nationwide

Despite these strengths, Tokyo's ecosystem presents a series of gaps relative to its potential as a leading global start-up ecosystem. These gaps can be addressed with policy actions that tackle existing market failures or catalyze organic growth through private sector actors and that attract start-up-oriented ecosystems stakeholders. These include the following:

(a) Attract and catalyze specialized actors for investment growth (for example, independent VCs) and international high-growth accelerators.
(b) Establish international investment standards for VC and start-up investment, similar to European investment guideline or the US Security Exchange Commission standard rules, to attract international scale-up funding
(c) Attract experienced global-oriented start-up talent and connect its ecosystem through structured global programs such as UK Global Entrepreneurship Program or K-Startup
(d) Support universities to partner with leading start-up universities to introduce start-up education based on practical expertise and university ecosystem building projects, such as at those of the University of California, Berkeley; Massachusetts Institute of Technology; or Stanford University
(e) Foster start-up ecosystem development in other non-Tokyo science and technology clusters (for example, Osaka-Kyoto-Kobe, Nagoya, and Fukuoka) and its integration with its corporate and university R&D innovation systems

A complete list of Tokyo's key gaps in the ecosystem and policy examples to address them is presented in tables 6.1 and 6.2.



Start-up Ecosystems
Are Critical Assets for Innovation-Driven Competitiveness

As economic transformation accelerates globally, knowledge, technology, and innovation have become strategic assets. The global economy is steadily adopting more intangible economic structures, and the pace will likely quicken (Haskel and Westlake 2018a).[2] Since the 2008 economic crisis, intangible investment has surpassed tangible, and the gap between the two has increased continuously (Haskel and Westlake 2018b). Knowledge creation, research, technology, and innovation have become a critical source of productivity and forward-looking growth (OECD 2013). Technological disruption has accelerated, powered by the intangible economy's[3] winner-takes-all dynamics, thereby transforming the global competitive landscape (World Economic Forum 2016). As of 2018, more than 90 percent of companies felt that their business models would soon need to adjust to keep pace with digital trends, a key driver of the intangible economy (Bughin et al. 2018). The average company age in the S&P 500 has been reduced from 61 years in 1958 to 22 years today (Fitzpatrick et al. 2020). By 2017, 9 of the top 10 highest-valued companies globally were technology firms with intangible business models (Wolf 2017). Now, COVID-19 is accelerating the pathway toward the intangible economy faster than before (Haskel and Westlake 2018a).

Start-ups have not only become critical assets for the creation of knowledge, innovation, and technology, but also for their rapid commercialization. Additionally, they are creating entirely new markets and transforming existing ones by leveraging business models of intangible economy (Audretsch and Belitski 2016).

With the reductions of barriers to innovate prompted by technology, start-ups became a more catalytic force (BCG and Hello Tomorrow 2021). The first wave of this evolution centered on information and communication technology and biotech sectors, resulting in myriad new companies that were disrupting industries and markets. This trend has continued and now expands to all other sectors with the advancement of deep-technologies (deep-tech) start-ups.[4] These companies influence industry transformation, as they rapidly commercialize new innovations and technologies. As of March 2021, there were more than 760 unicorns.[5] Advances in deep tech are enabling start-ups to operate at the core of knowledge, innovation, and technology generation coupled with start-ups' traditional advantage in commercializing new products and services. A recent report by Boston Consulting Group and Hello Tomorrow (BCG and Hello Tomorrow 2021) estimates that 96 percent of deep-tech start-ups use at least two technologies, with 66 percent applying an advanced technology. Seventy percent of these start-ups own patents on the technology they use. The recent development of COVID-19 vaccines where start-ups such as Moderna and BioNTech led efforts with a new messenger ribonucleic acid (mRNA) technology is an example of this central role of start-ups in deep-science innovation and rapid commercialization (BCG and Hello Tomorrow 2021; CDC 2021).

2 Haskel and Westlake (2018a) found that over the past 20 years there has been a steady rise and importance of investment in intangible assets relative to tangible assets investment. Intangible investment relates to nonphysical assets, such as software, design, brands, organizational capabilities, and so forth, forming the intangible capital. Tangible investment relates to physical assets, such as building or physical goods. By 2013, in the developed economies analyzed by Haskel and Westlake (that is, United States and 11 European Union countries), intangible investment had surpassed tangible investment already by 10 percent with a growing trend. Intangible assets have different properties that have a substantial effect on the economy. This includes (a) the ability to scale firms over their operations faster and wider than those leveraging tangible assets (for example, Airbnb rapid global expansion as compared with physical asset–based major hotel companies); (b) spillovers, which allow other firms to use intangible assets from any other firm, which cannot

happen with physical assets; (c) sunkenness, which refers to the inability to resell intangible assets; and (d) synergies, which refer to the increase value of intangible assets when combined with other intangible assets (for example, Google or Facebook combining data from their online platforms to develop artificial intelligence systems that provide new products and services for clients forming unique value propositions for customers). As intangible investment has expanded, these characteristics have created new dynamics on the economy among economic actors and market competition. We refer to these new dynamics as "intangible economy structures."

3 Following Haskel and Westlake (2018a), we refer to the intangible economy as the assets and economic actors that operate with intangible assets and business models, based on the intangible assets' unique properties. Technology and digitalization have been key driving forces in the creation and expansion of the intangible assets and dynamics across sectors.

Box I.1: Start-up–Led Innovation Model Is Becoming More Efficient, Even for Deep-Tech Innovation

Start-ups' role in pioneering advances in fusion reaction is a case study of how small, young tech companies are overcoming the traditional innovation model, which has historically been based on high-cost research and development driven by public and multinational corporation (MNC) scientific labs and facilities operating in isolation from the larger ecosystem. As a source of energy, fusion reaction has been one of the most complex scientific challenges in the past decades. Whereas the technology to achieve power out of fusion reaction is scientifically possible, the technology is not economically feasible as the process consumes more energy than it produces. However, the upside of achieving fusion reaction is immense, as it would lead to producing an unlimited amount of clean energy.

The traditional model of innovation — led by corporations and public entities and consortiums — has resulted in no feasible technological application yet despite high continuous investment over the past decades. Two initiatives, the US National Ignition Facility (NIF) and the International Thermonuclear Experimental Reactor (ITER) consortium — which comprises 35 countries, including China, India, Japan, Republic of Korea, and the United States — have been in place since the mid 1990s and mid 2000s, respectively. They both have budgets of billions of dollars (beyond US$20 billion in the case of the ITER), and although they have achieved valuable scientific milestones, none has yet produced a feasible technology for fusion reaction. ITER currently plans to achieve a successful, cost-effective fusion reaction by 2035. In the meantime, and in a more agile manner, start-ups have also started to enter this high-tech field and are operating on shorter time lines, which could lead to tangible results more quickly than these larger scale, high-budget initiatives. For instance, Commonwealth Fusion Systems is a Boston start-up founded in 2018 with funding of US$264 million to build the first net-gain fusion reactor by 2025. Other start-ups with similar levels of funding (for example, General Fusion and TAE Technologies) are also developing plans for fusion reaction.

The emergence of start-ups competing in this highly advanced deep-tech arena is not unique to fusion reaction but is a widespread phenomenon. For example, regarding space technologies, SpaceX, Blue Origin, and others are achieving tangible results competing with national and international space programs. Likewise, in the vaccination domain, BioNTech and Moderna developed a solution for the COVID-19 vaccine through a completely new scientific approach with mRNA (messenger ribonucleic acid), built faster than the traditional MNC vaccine manufacturers (for example, GlaxoSmithKline, Merk, and Sanofi). Start-ups have become a critical asset for both the generation and commercialization of innovation and technology. An innovation ecosystem that does not incorporate start-ups risks losing competitiveness.

Sources: BCG and Hello Tomorrow, 2021; ITER, https://www.iter.org; Kuchler and Abboud, 2021; Tracxn, "Top Nuclear Fusion Startups," https://tracxn.com/d/trending-themes/Startups-in-Nuclear-Fusion; US Government Accountability Office for the NIF budget, https://www.govinfo.gov/content/pkg/GAOREPORTS-GAO-01-677R/html/GAOREPORTS-GAO-01-677R.htm.

Because of their problem-solving orientation, start-ups are especially relevant to address grand challenges, such as the one posed by COVID-19 or climate change. Coupled with the appropriate incentives, funding, and resources (for example, Operation Warp Speed for vaccine development), start-ups can rapidly contribute to the development of prototype solutions and inventions to advance faster in tackling these challenges (see box I.1). Start-ups are also attracted to grand challenges. Of the surveyed deep-tech start-ups analyzed by BCG and Hello Tomorrow (2021), more than half of them address a Sustainable Development Goal, with many addressing multiple ones.

Since 2008, the emergence of unicorns and platform-led companies has transformed the global competitive landscape. Companies such as Uber, Didi, and Grab in transportation, Airbnb in hospitality, and Tesla in electric vehicles are examples of how this transformation has come to fruition. Similarly, advances in quantum computing, advanced artificial intelligence (AI) and robotics, bioengineering, space technology, advanced materials, and blockchain are riding this wave. Because start-ups not only create and develop these advanced technologies, but also commercialize and launch them, the speed to market for these innovations is hastened (see box I.1). As these trends accelerate globally following the technology-boost produced by COVID-19, countries that produce start-ups in deep tech will likely see the competitiveness of its firms increasing relative to others that do not develop and leverage these new technologies and markets.

Start-ups can not only create new industries, but they can also generate new sources of employment. Although these firms also eliminate jobs as the process of creative destruction, the jobs created are in new markets driven by the intangible economy and can result in better employment quality,[6] as suggested by some specific country studies (Castillo et al. 2014; Choi, Song, and Park 2020). New jobs are a common byproduct of start-ups, as these ventures create new technology products, services and, increasingly, new entire markets leveraging platforms and deep technologies (Kane 2010). In Organisation for Economic Co-operation and Development (OECD) countries, young firms create nearly half of new jobs, and it is not uncommon for a particular cohort of fast-growing start-ups to create a disproportionately large number of new jobs. For example, between 22 percent of new jobs in Netherlands and 53 percent in France are created by start-ups (Calvino, Criscuolo, and Menon 2016). This influence can have a multiplier effect as well: in the United Kingdom, for every 10 new high-tech jobs created, 6 low-skilled workers also gain employment. Deep-tech ecosystems in particular can have a notable effect on job creation as they enhance industries reliant on science, technology, engineering, and mathematics (STEM) and also trigger knowledge spillovers from universities that incubate deep-tech start-ups (Lee and Clarke 2019).

This creation of new markets and jobs is particularly relevant for COVID-19 postrecovery, which will further accelerate the transition to digital technologies and intangible economy business models and dynamics boosted by the pandemic (McKinsey & Company 2020a; 2020b). This transition will likely have direct effects on countries' competitiveness and economic growth, as the inequality gap between those countries developing and adopting digital technologies and intangible economic business dynamics further enlarges in this transition (UNCTAD 2021).

Start-ups do not grow in a vacuum; they require well-functioning ecosystems that are highly connected to knowledge, innovation, and technology. For start-ups to grow, they need an ecosystem that provides access to financing, talent, and a business environment that allows them to thrive (Mason and Brown 2014). Absent these conditions, ecosystems do not produce sustainable scale-up firms that can compete globally. Global cities play a critical role in creating competitive start-up ecosystems and innovation hubs. Start-up ecosystems are often concentrated in large, highly connected, cosmopolitan metropolitan areas (Florida and Hathaway 2018). Venture Capital (VC) is also highly concentrated in global cities, with 24 cities accounting for two-thirds of all VC investment across the world, as of 2018 (Florida and Hathaway 2018). The same pattern is emerging with innovation hubs such as knowledge, innovation, technology, and scientific production hotspots and clusters. Innovation hubs are increasingly concentrated in large metropolitan areas, with 22 of the 35 most-populated cities in the world being global innovation hubs (WIPO 2019). High connectivity with international centers of global ecosystems and hubs that global cities, such as Tokyo, is critical for countries to produce domestically competitive innovation and technology ecosystems.

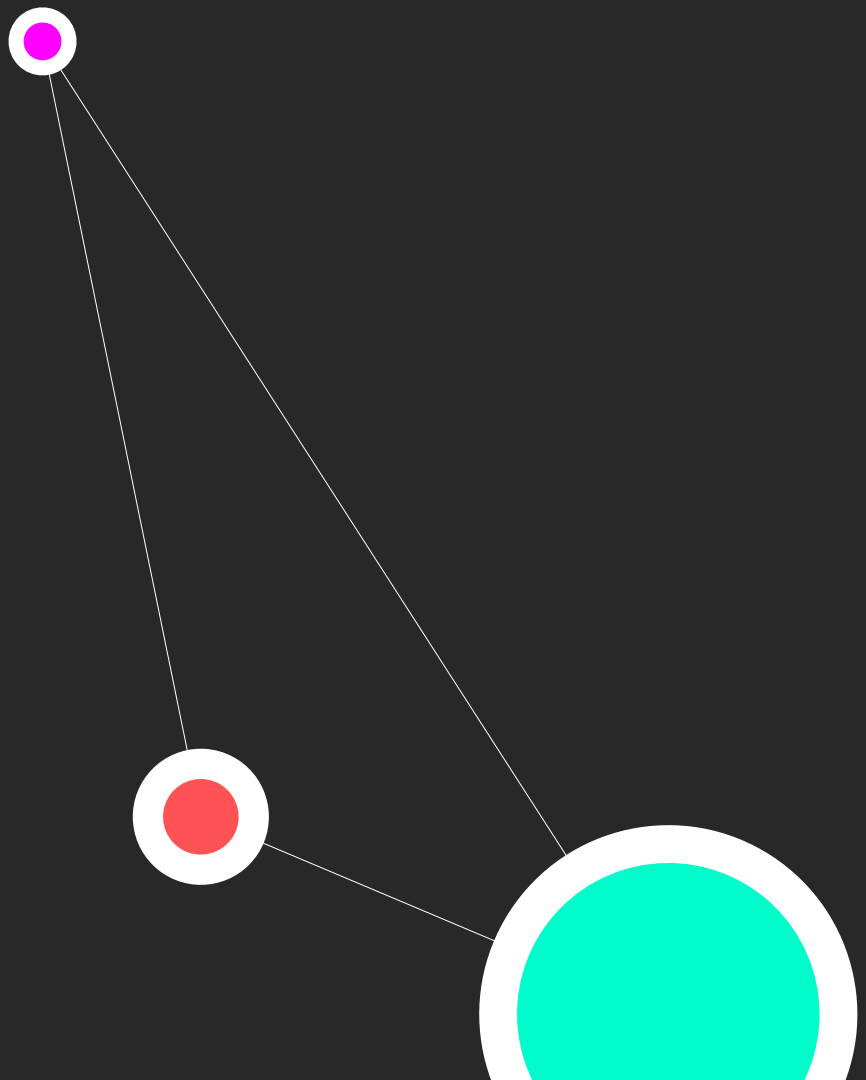
4 Deep technologies are new advanced technologies that require substantial R&D to develop practical commercial applications. These technologies usually have the potential to create new markets or disrupt existing industries, by creating new paradigms. Examples of deep technologies are advanced materials, artificial intelligence, robotics, biotechnology, blockchain, or quantum computing (BCG 2019).

5 This list includes both privately held companies, which are referred to as "unicorns," and publicly held or other independently owned companies that have been VC backed and have been valued at US$1 billion or more. The data source is the CBInsights list of unicorn companies and "Exit" unicorn companies, which include previous unicorn companies that have exited VC funding and can be now publicly traded (CBInsights 2021, n.d.).

6 Employment quality is understood by wage level, employment stability, vocational training and development potential, career

opportunities, working hours, social security, work-place-family balance, and organizational commitment.

7 In the report by World Intellectual Property Organization (WIPO 2019), we refer to innovation clusters or hubs as a metropolitan area or conurbation with high concentration of scientific knowledge and innovation outputs (for example, scientific publications and patents) following the WIPO identification.



Section 1

Japan's Innovation Ecosystem: A Leading Global Innovation Hub with a Lagging Start-up Ecosystem

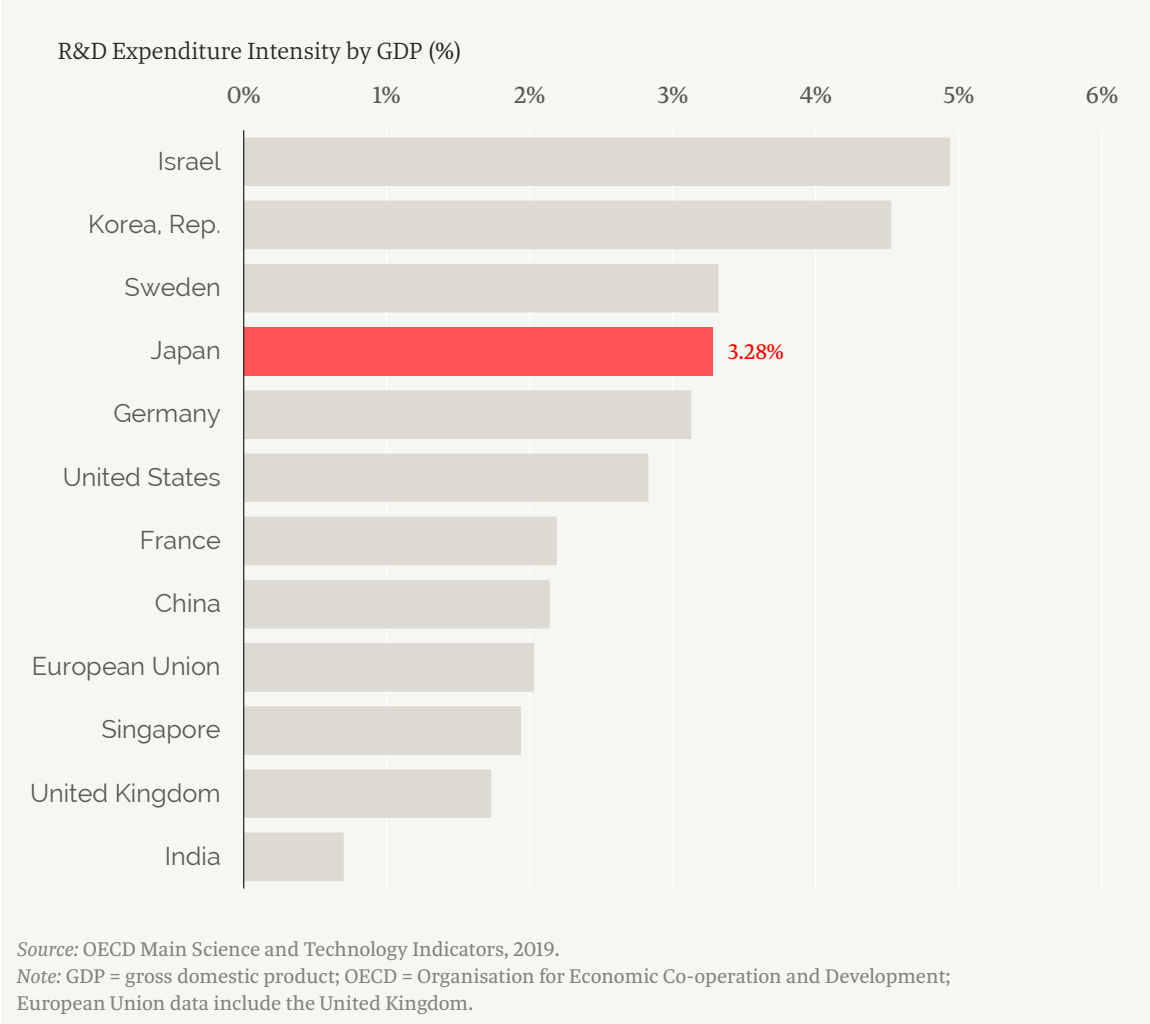
Japan has one of the most advanced innovation ecosystems globally, with major global innovation hubs, top science and knowledge producing universities, and a strong corporate sector investing considerably in research and development (R&D). However, this traditional innovation ecosystem is not paired with an equally robust and capable start-up ecosystem. This situation is limiting the production of outputs, particularly on commercialization and the innovation competitiveness of Japan's private sector when compared with other countries. Expanding the start-up ecosystem will provide Japan with enhanced potential for innovation and advanced technology outputs.

1.1 Japan has a globally competitive traditional innovation

Japan is one of the leading global producers of science and technology innovations, with a strong supporting traditional innovation system. With an annual R&D investment of US$170 billion in 2008, Japan has the third largest share of R&D expenditure among Organisation for Economic Co-operation and Development (OECD) countries and partner countries (including China and Singapore) and the fourth largest share as an economic area with 9 percent of all R&D expenditure of all these countries (see figure 1.1). Japan has one of the highest R&D intensity levels (R&D per gross domestic product [GDP]) in the world, producing some of the largest numbers of scientific publications and patents globally (Dutta, Lanvin, and Wunsch-Vincent 2020).

Japan is home to advanced universities and research centers, hosting several global leading science and technology clusters. The country has 5 of the 100 leading clusters worldwide producing scientific publications and patents, with Tokyo ranking first and Osaka-Kobe-Kyoto and Nagoya also ranking among the top 15 in the world according to the 2020 Global Competitiveness Index (Dutta, Lanvin, and Wunsch-Vincent 2020). The University of Tokyo, Kyoto University, and Nagoya University are all top scientific organizations in these clusters. Similarly, Japan has had the 6th most Nobel prize laureates of any country since 1901, with Kyoto University ranking 11th in the natural sciences field (physics, chemistry, physiology, and medicine) since 2000 along with John Hopkins University and Columbia University (*Economist* n.d.; Nobel Prize n.d.). Moreover, Japan has one of the highest ratios of granted

Figure 1.1:
R&D Expenditure Intensity by GDP Across Select OECD Countries



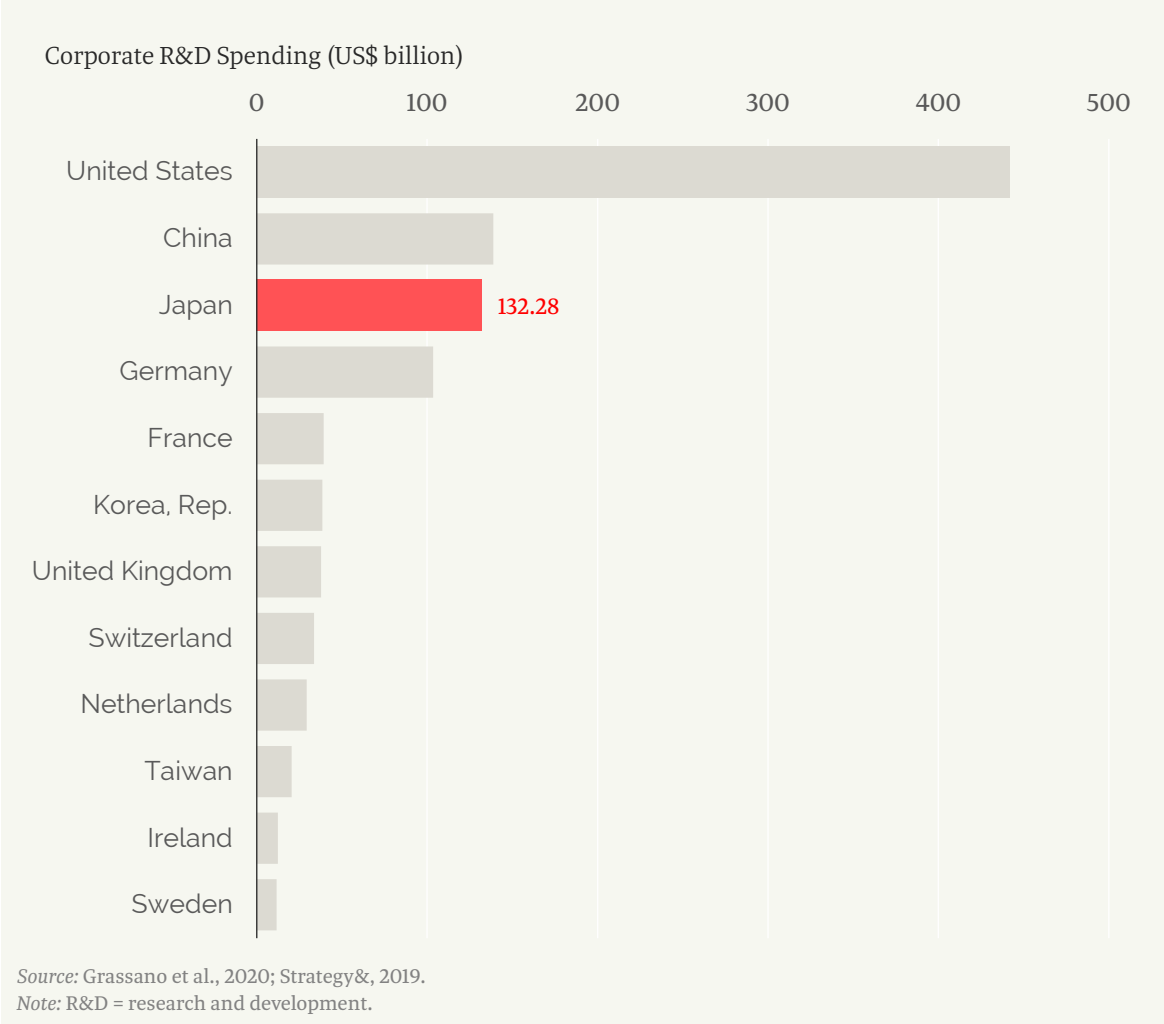
Source: OECD Main Science and Technology Indicators, 2019.
Note: GDP = gross domestic product; OECD = Organisation for Economic Co-operation and Development; European Union data include the United Kingdom.

applications of patents (with 60 percent or more since 2010, as compared with 25 to 30 percent in China or between 45 and 60 percent in the United States).[8]

Large corporations also play a notable role in Japanese innovation and the system surrounding it. The country is home to a large share of multinational corporations competing globally, with more than 200 companies in the Forbes Global 2000 list, the third largest share of large corporations after the United States and China (*Forbes* 2021). Of the world's 2,500 publicly traded companies disclosing R&D investment, Japan has more than 300, representing 12 percent, the third largest amount globally. These multinational and local corporations have invested one of the highest amounts of R&D worldwide, resulting in the third largest amount globally, following the United States and China (see figure 1.2).

8 "World Intellectual Property Indicators 2018," WIPO, Geneva, https://www.wipo.int/edocs/pubdocs/en/wipo_pub_941_2018-chapter2.pdf; WIPO Country Profiles, https://www.wipo.int/ipstats/en/statistics/country_profile/#J.

Figure 1.2:
Corporate R&D Spending Across Select Countries (US$ billion)



Source: Grassano et al., 2020; Strategy&, 2019.
Note: R&D = research and development.

1.2 Japan's start-up ecosystem lags its innovation system

In contrast to its larger innovation system, Japan's start-up ecosystem has underperformed, in particular when compared with other leading global economies. The country had one of the lowest venture capital (VC) investment intensity levels — VC investment by GDP — among OECD member and partner countries with only 0.08 percent in 2019 as compared to 0.23 percent in China and 0.64 percent in the United States. Innovation-led economies such as Israel, Singapore, or Sweden have a much higher VC intensity (see figure 1.3), suggesting that on the whole the Japanese economy is investing in start-ups at a lower rate than other OECD countries, and it is producing relatively fewer unicorns as well. Consequently, Japanese VC investment is a small part of global VC activity, with only 1.4 percent of the global share (see figure 1.4). Hence one can argue that the country's ecosystem is underperforming relative to its potential.

Figure 1.3:
Venture Capital Intensity by GDP

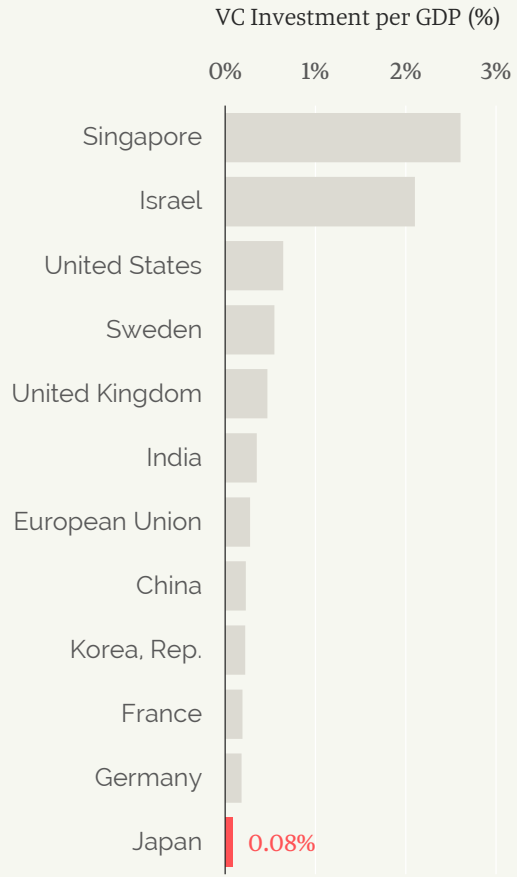
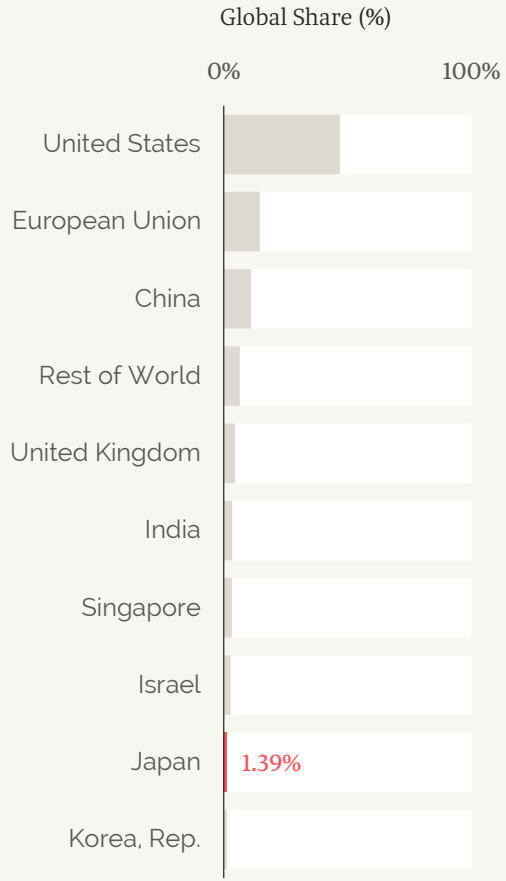


Figure 1.4:
Global Share of Venture Capital Investment, 2019



Sources: For the United States — National Venture Capital Association, 2020; for China — Sheng, 2020; for the European Union and the United Kingdom — Dealroom, 2020; for India — Sheth, Krishnan, and T, 2020; for Japan — INITIAL, 2021; for Israel, Republic of Korea, and rest of the world — Rowley, 2020; for Singapore — Pillai, 2019; KPMG 2019.
Note: Singapore only covers Q1–Q3 data.

Japan's start-up ecosystem has created a limited number of unicorns, with 11 recorded as of January 2021. This number is lower than other large or high-income economies, including China, Germany, India, the United Kingdom, or the United States, as well as smaller economies, such as Israel or the Republic of Korea, all of which have long track records in intensive innovation. It also contrasts with the position of Japan's economy in global companies. Japan is home to the third largest number of global companies, yet in unicorns, it stands at the level of Israel, an economy with a GDP more than 12.8 times smaller than Japan (see figure 1.5 and figure 1.6).

Figure 1.5:
Number of Unicorns per Country, 2021

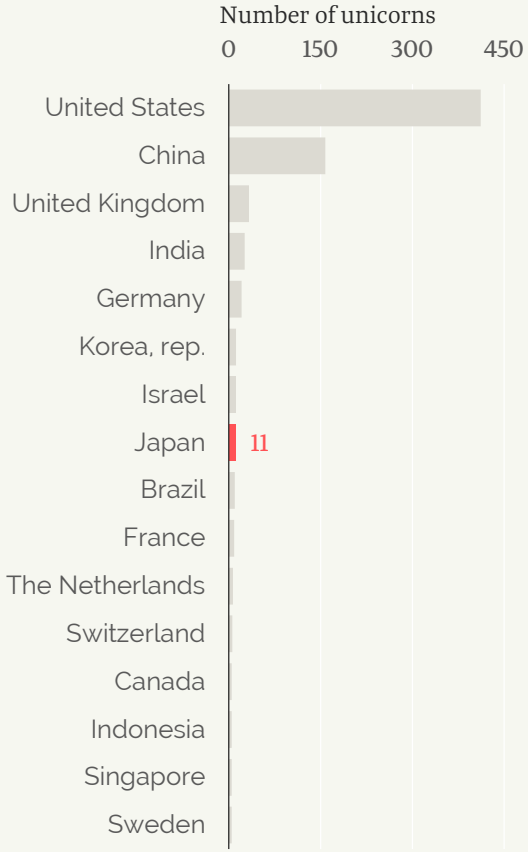
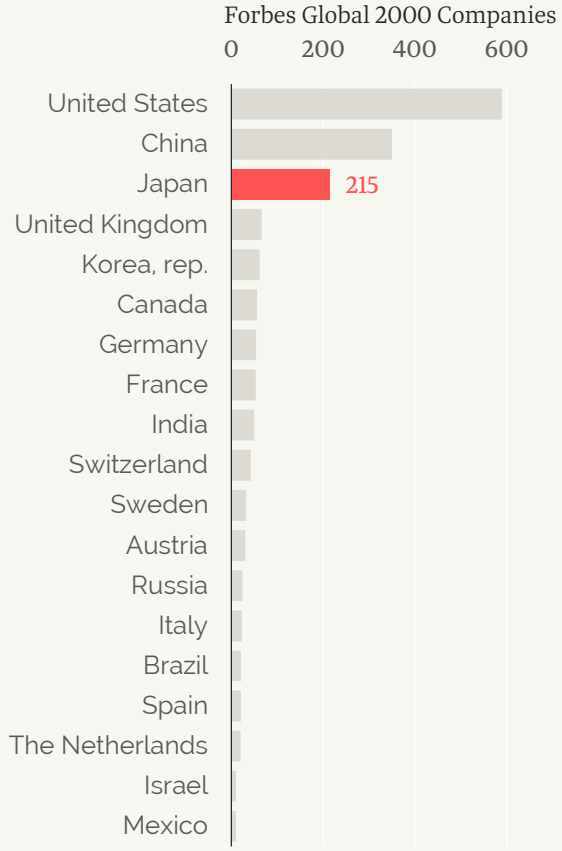


Figure 1.6:
Number of Forbes Global 2000 Companies per Country, 2021

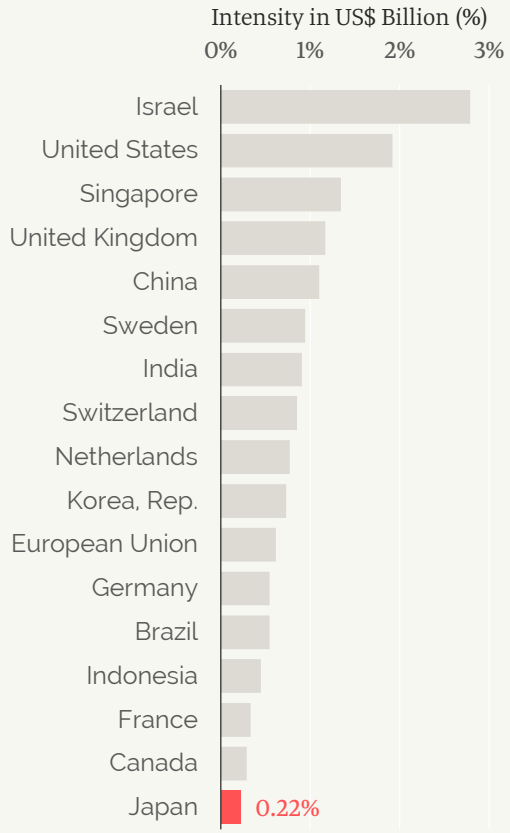


Sources: CBInsights, 2021, n.d.; INITIAL, 2021; Forbes, 2021.

Similar to VC intensity measures, when compared by the intensity of unicorns (unicorns per GDP), Japan has the lowest number of all countries that have produced five or more of such companies (see figure 1.7). A similar lag is observed when focusing on the deep-tech industry. A recent study based on 8,600 deep-tech ventures identifies more than 360 companies (about 4 percent) in Japan within seven deep-tech categories: advanced materials, AI, biotechnology, blockchain, robotics, photonics and electronics, and quantum computing. Of Japan's 11 unicorns, 6 (Preferred Networks, QUOINE, Clean Planet, TBM, Spiber, and TRIPLE-1) leverage deep tech. And yet, Japan's GDP intensity of deep-tech companies is lower than other peer countries. Japan's GDP intensity is 7 percent as compared to 49 percent in Israel and 20 percent in the Republic of Korea, Sweden, Switzerland, and the United States, suggesting that there is potential for further growth (see figure 1.8).

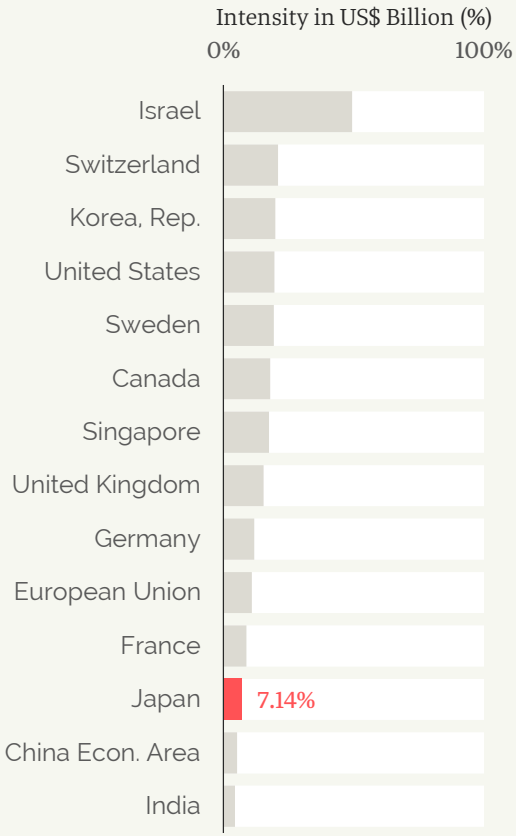
Japan's ecosystem is highly reliant on the Greater Tokyo area, which is home to the vast majority of the country's start-up activity. More than 80 percent of start-up funding is concentrated in Tokyo, which is also home to 9 of 11 unicorns in the country. Japan has start-up activity in other ecosystems — most notably Nagoya and Fukuoka in the Osaka-Kobe-Kyoto area — but these cities produce only early-stage financing and have a much smaller community of ecosystem resources and actors (see figure 1.9).

Figure 1.7:
Intensity of Unicorns by GDP, Across Select Countries



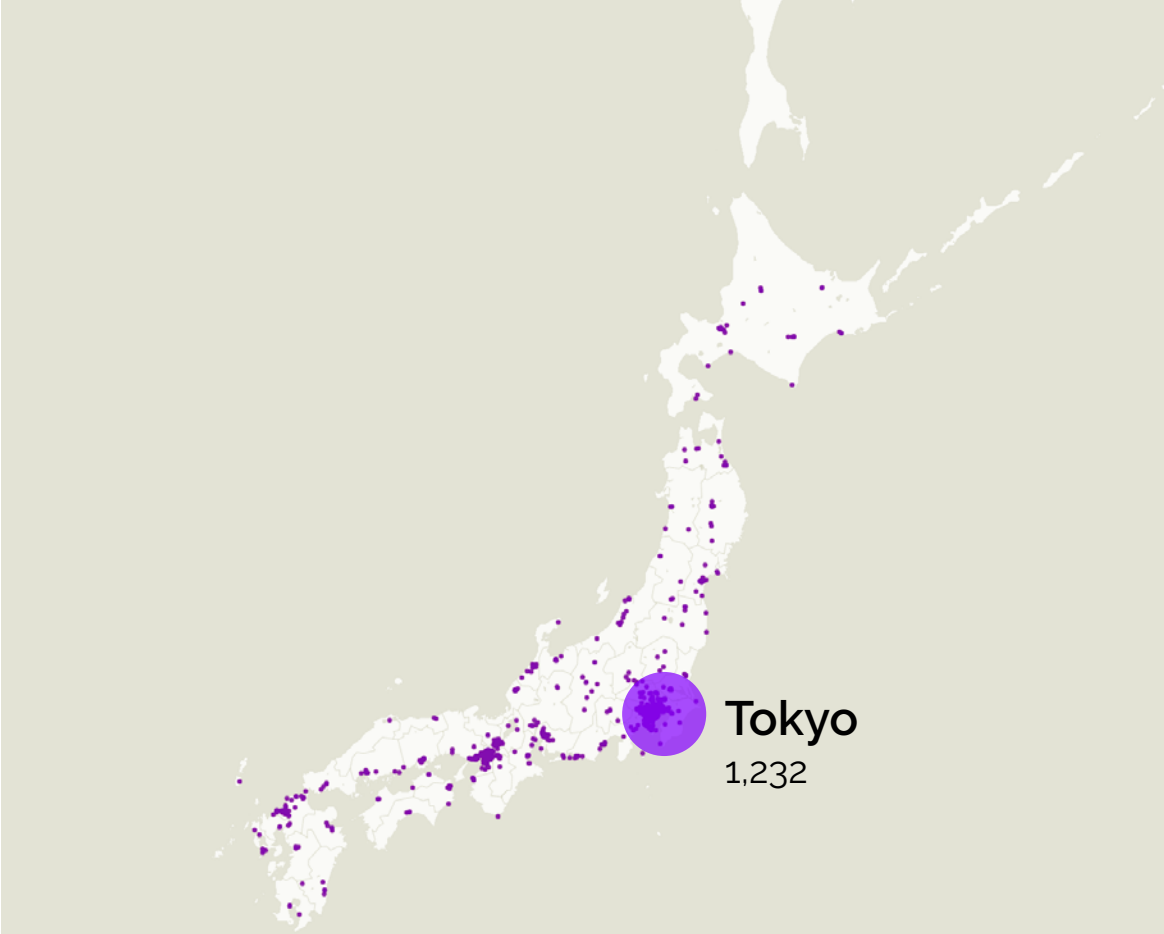
Source: CBInsights, 2021a, n.d.; INITIAL, 2021; World Bank database, https://data.worldbank.org/indicator/NY.GDP.MKTP.CD.
Note: GDP in US$ billions.

Figure 1.8:
Intensity of Deep-Tech Start-ups by GDP Across Select Countries



Source: BCG and Hello Tomorrow, 2019; World Bank database, https://data.worldbank.org/indicator/NY.GDP.MKTP.CD.
Note: GDP in US$ billions. China data include start-ups from expanded China economic area as per source.

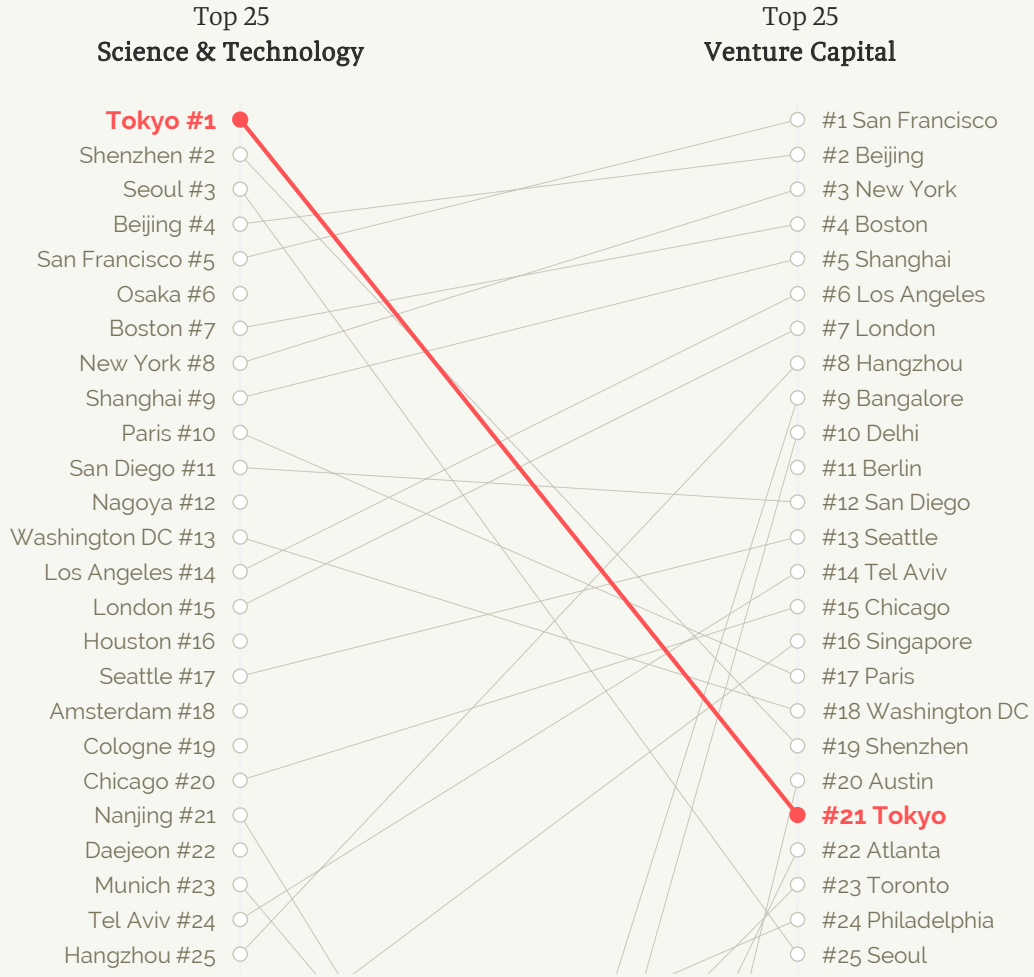
Figure 1.9:
Geographic Start-up Activity Concentration in Japan



Source: Authors' analysis based on survey data, enriched with complementary sources (see Appendix A: Methodology).
Note: Clusters of start-up stakeholders include start-ups, investors, support programs and skill providers, and others. Number of Tokyo start-ups refers to start-ups in international database (see figure 2.2).

The high reliance of Japan's ecosystem on only one cluster contrasts with other peer economies with leading start-up ecosystems. China, India, and the United States, as well as the European Union, have all developed multiple global ecosystem hubs that are not concentrated in a single metropolitan area. For example, the United States has 12 ecosystems that have produced more than five unicorns. China is home to six of those ecosystems, and the European Union is home to five, whereas India has two metro areas with more than 10 unicorns each (CBInsights 2021, n.d.; INITIAL 2021). In contrast to the country's only global start-up cluster, Japan is home to three leading global science and technology clusters, with the Greater Tokyo area, Osaka-Kobe-Kyoto, and Nagoya in the top 12 clusters in output (patent and publication) and quality performance (Dutta, Lanvin, and Wunsch-Vincent 2020). This discrepancy between high performing science and technology clusters and a smaller start-up cluster differs from other leading innovation economies, which all have multiple and paired high-performance innovation start-up clusters across their geography (see table 1.1).

Table 1.1:
Ranking of Science and Technology Clusters and VC Clusters Across Select Countries



Sources: Dutta, Lanvin, and Wunsch-Vincent, 2020; Florida and Hathaway, 2018.
Note: VC = venture capital; italics represent a cluster ranking beyond top 25 in its category. The World Intellectual Property Association's Global Innovation Index provides a ranking of science and technology clusters based on inventors listed on patent applications, authors listed in scientific publications, and the geocoding of inventor and author addresses along with density-based spatial clustering algorithms. For further details of the methodology of this index, see Dutta, Lanvin, and Wunsch-Vincent (2020). The VC cluster ranking is based on capital invested by VC firms from 2015 through 2017. For further details of the methodology of this index, see Florida and Hathaway (2018).

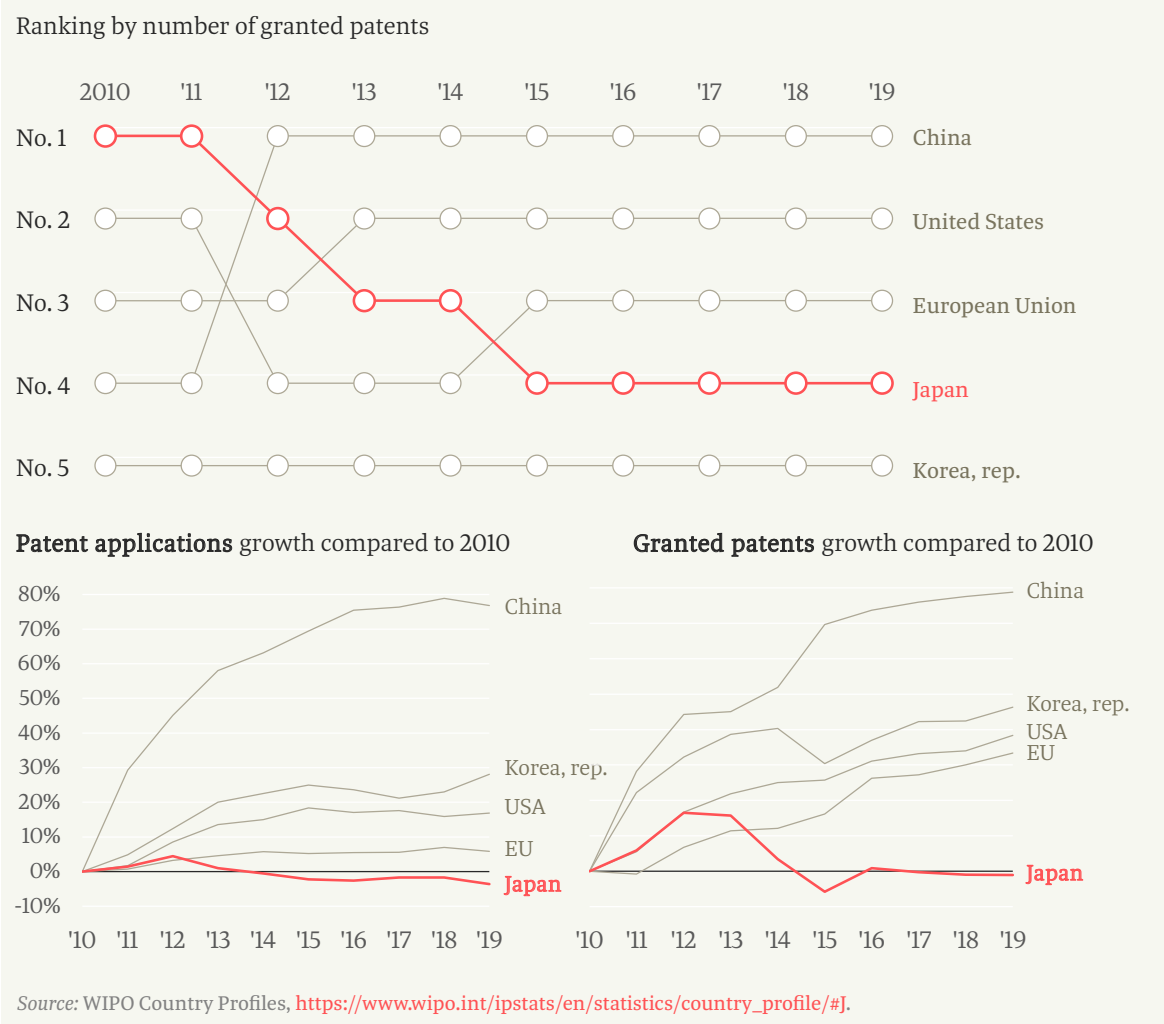
1.3 The Japanese innovation system needs a larger start-up ecosystem to grow

Japan's relatively less developed start-up ecosystem has not yet been able to provide the adequate synergies between its start-up community and its larger innovation ecosystem. Countries with thriving start-up ecosystems have successfully combined the advancements in open innovation with their start-up ecosystems. In contrast to China, the United States, or the European Union, Japan has only one global start-up ecosystem and, consequently, lower capacity to attract start-up talent and capital than its peers. For instance, Tokyo produces only 0.6 percent of VC funding globally (2015–17), having one of the lowest VC intensities among countries with global innovation hubs (Florida and Hathaway 2018).

Despite Japan itself representing a high percentage of global R&D, at the firm level Japanese companies are losing R&D competitiveness, with only one company (Toyota) in the top 25 corporations with the largest R&D investment levels globally. In 2010, 8 Japanese companies were included in the 15 most innovative companies by EconSight, which ranks companies based on relevant technology and patent generation (EconSight 2019). However, by 2019 only two (Sony and Toyota) remained in the rankings. By 2022, QUICK FactSet Workstation projects that the five largest US technology firms (Alphabet, Amazon, Facebook, Apple, and Microsoft) will have a larger R&D investment than the entire Japanese private sector (Matsuo, Maruyama, and Goto 2020).

Although Japanese corporations have traditionally filed a significant number of deep-tech patents, such as in artificial intelligence (AI) and robotics, this position is eroding. Whereas Japan held the largest or second largest share of

Figure 1.10:
Growth in Patent Applications and Granted Patents Across Select Countries, 2010–2019



Source: WIPO Country Profiles, https://www.wipo.int/ipstats/en/statistics/country_profile/#J.

patent applications filed in 2001 in 10 critical deep technologies (that is, AI, quantum computing, regenerative medicine, autonomous driving, blockchain, cybersecurity, virtual reality, lithium-ion batteries, drones, and conductive polymers), by 2017 its position decreased to fourth in seven of these categories, behind the United States, China, and the Republic of Korea (Kodaka et al. 2020).

This trend is reflected in the overall patent generation of the country. Whereas Japan was the global leader in patents granted in 2010, it has since been overcome by China, the United States, and the European Union. In fact, Japan is the only country of the top five largest patent generators that has registered negative growth for both patent applications and granted patents (figure 1.10).

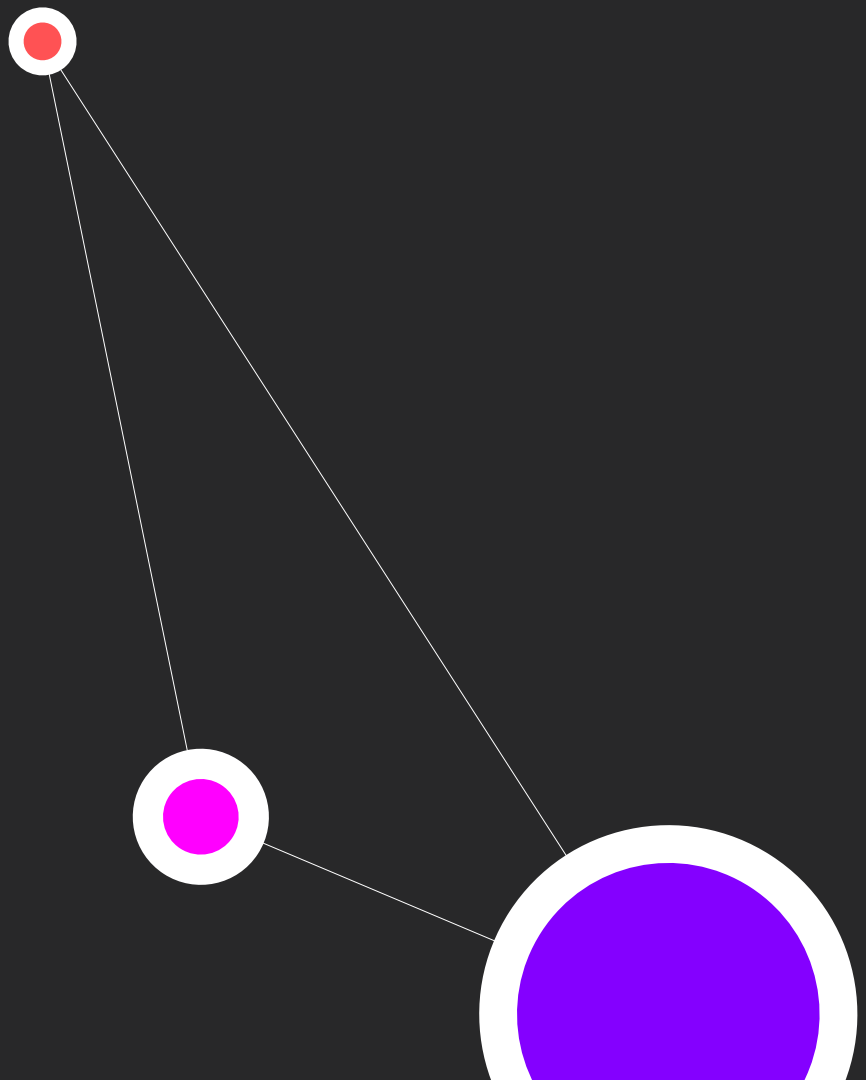
The further development of Japan's start-up ecosystem to similar levels of peer countries would support the creation of a larger number of new technologies, markets, and firms. This dynamic is particularly relevant with the acceleration of technology-driven business models propelled by COVID-19 and its postrecovery dynamics (McKinsey & Company 2020b). The country is well positioned today to leverage this opportunity and push further in the development of its start-up ecosystem. Japan has a history of successful entrepreneurship and creation of technology-driven innovative companies leveraging a global crisis and a transformational trend, just as the current one with COVID-19 and the transition toward intangible economy business models. During World War II and its aftermath, Japan created a wave of companies that become technology and innovative global leaders, such as Panasonic, Canon, Toyota, Honda, Sony, and Nintendo (Kagami 2014).

Key *takeaways*

1. **Japan is well positioned to develop a leading global start-up ecosystem.** The country has several notable economic assets and institutional advantages that lend themselves to building the start-up ecosystem. For instance, Japan is home to several leading science and technology clusters, with the Greater Tokyo area, Osaka-Kobe-Kyoto, and Nagoya, which rank in the top 12 clusters globally in output (patent and publication) and quality performance. Japan is still one of the leading countries in the production of science and technology innovations, with a strong supporting traditional innovation system. The country is also home to a large share of multinational corporations competing globally, with 215 companies on the Forbes Global 2000 list, the third largest share of large corporations on the list after the United States and China. Furthermore, in its start-up ecosystem, Japan has started to produce globally competitive outputs with 11 unicorns.

2. **However, Japan's start-up ecosystem is presently underdeveloped and limited compared with its potential.** When compared with other leading global economies, Japan's start-up ecosystem still has much room to grow, and the country could benefit from ensuring that its start-up community synergizes with the larger innovation ecosystem. For example, Japan has a relatively low number of deep-tech companies and unicorns when compared with other leading ecosystems. Regarding funding for start-ups, unlike other leading ecosystems, Japan is a net exporter of capital, which suggests that there is not enough critical mass of investment-ready opportunities for VC and corporations alike. Additionally, Japan's only advanced start-up ecosystem is in Tokyo, meaning that the entire country relies heavily on just one city to realize outcomes for its entrepreneurial ventures.

3. **Japan innovation competitiveness is declining with an insufficient production of new technology-led ventures to offset this.** In parallel to the evolution of innovation models toward start-up innovations globally, Japanese companies have been losing R&D competitiveness, with only one company (Toyota) in the top 25 global corporations with the largest R&D investment levels. Since 2010, Japan has experienced a relative reduction in innovation outputs. While the country was the global leader in patents granted in 2010, it has since been overcome by China, the United States, and the European Union. In fact, Japan is the only country of the top five largest patent generators that has registered negative growth for both patent applications and granted patents.



Section 2

Tokyo Start-up Ecosystem

2.1 Introduction to Start-up Ecosystems

Start-up ecosystems are essentially communities comprising a diverse range of organizations that support start-ups in myriad ways, enabling knowledge spillovers to occur and opening access to critical resources for entrepreneurs through a network of embedded connections. The tighter and more connected an ecosystem is, the more efficient this flow of knowledge and access to resources is. The less connected it is, the less effective the ecosystem is to spot talent and nurture potential ventures into successful start-ups. The main elements of the start-up ecosystems are described in table 2.1.

Table 2.1:
Elements of Start-up Ecosystems

Element	Description
Community / Social Network	Social networks are a critical element of start-up ecosystems. They help identify entrepreneurial opportunities, access to finance, access to information and help create resources and spillovers, strategic alliances, and status signaling (Coleman, Katz, and Menzel 1957; Drori, Ellis, and Shapira 2013; Kalnins and Chung 2004; Shane and Stuart 2002; Stuart, Hoang, and Hybels 1999; Stuart and Sorenson 2003; and Uzzi 1999). Start-up ecosystem's social networks connect all other elements of the ecosystem so entrepreneurs can gain access to the resources needed to create start-ups, forming the ecosystem's social capital. This element is transversal and is present throughout all the ecosystem.
Investment	Investment encompasses the funding resources available to entrepreneurs and stakeholders in the ecosystem. It comprises the population of investment entities in an ecosystem including early-stage angel investors, venture capital (VC) funds, corporate venture funds, and late-stage private equity funds, as well as various university, government, and nonprofit financing organizations.
Support Infrastructure	Support infrastructure refers to all the programs and resources available to entrepreneurs in an ecosystem to support their creation of start-ups. Accelerators are arguably the most active and renowned player in this domain, supporting entrepreneurs and start-ups in the early stages of development, provision of small amounts of seed investment, and active mentorship and networking, among other services. This domain also includes mentorship: mentorship is a way to transfer knowledge so that entrepreneurs acquire business acumen; understand the unspoken rules of start-up challenges; and access networks of talent, knowledge, and resources.
Skills Infrastructure	Skills infrastructure includes all the available institutions that provide relevant skills in the ecosystem for entrepreneurs to create competitive ventures. Universities and specialized training organizations such as coding boot camps are the most common players in the skills domain. In particular, university programs and nonuniversity training initiatives that provide students with exposure to the start-up process and entrepreneurship education are particularly important in forming the bedrock of skills in an ecosystem. Accelerators also play a critical role, as do other experiential learning-by-doing entrepreneurial programs.

Sources: These elements are based on Vedula and Kim, 2020; Cohen, 2004; and Neck et al., 2004.
Note: These elements are simplified for analysis purposes. Formal and informal networks and the supportive entrepreneurial culture are combined in community and social networks, universities and talent (human capital and innovation capacity) in skills infrastructure, and government and professional support services (formal support organizations) in support infrastructure. Capital services (access to finance) is referred as investment. Physical infrastructure and culture are not included in this analysis, except for when it influences any of the other components.

Because ecosystems are a combination of actors and factors that are interdependent and need to interact with each other to produce ventures, ecosystems need to develop these different domains in parallel. Prioritizing one area over the other can lead to uneven growth and lackluster outputs (Mason and Brown 2014). For example, emphasizing investment while not paying equal attention to promoting mentorship or accelerator development will have drawbacks. Developing the different elements of the ecosystem in tandem is also facilitated by having a healthy social network that connects the different players and helps to promote more organic growth and a more robust ecosystem in general. Larger, more diverse ecosystems can also operate with higher levels of efficiency. For example, the New York ecosystem is robust and has myriad players across the different domains. This size helps to enable a higher level of efficiency, and therefore can more easily absorb new start-ups and help them navigate in the ecosystem.

When discussing the different domains in an ecosystem it is also important to note the role of specialized and nonspecialized organizations. For this report, we define specialized organizations as ones that are designed to specifically support entrepreneurs and start-ups, such as VC funds and business accelerators, and also to operate independently of a corporation, government, or university. Contrastingly, we define nonspecialized organizations as entities that play a role in the ecosystem, and may have specific programs that work with start-ups, but the organizations themselves are not designed to work with start-ups. In this group, we often find universities, corporations, banks, and government programs. All of these entities play a role in the ecosystem yet typically are not created with the explicit purpose to support start-ups.

This distinction among specialized and nonspecialized actors is relevant because specialized actors' incentives are aligned with start-up growth and cater their services and support toward that goal, whereas nonspecialized actors have other incentives that may compete with start-up growth (Cohen 2004). For instance, banks and financial traditional institutions offer risk-averse finance based on debt and not on equity, which is not suited for technology start-ups because start-ups business models rely primarily on intangible assets. The objective of corporations is to address their business needs, not those of start-ups. This aim can lead to a focus on innovation acquisition and removal of the market, thus catering their corporate support programs toward that goal. Specialized actors not only offer support to entrepreneurs, but also provide access to networks that increase the flow of relevant knowledge for start-ups (Cohen 2004).

Because the importance of these connections are for the ecosystem, we employ a social network analysis to analyze the ecosystem (see box 2.1). When assessing actors and connectivity in the ecosystem's social network, we look at centrality measures. For the most in-depth analysis based on social networks and connectivity, we compared Tokyo's with New York City's, for which we have similar survey data collected in 2014–15. Even though the New York City ecosystem has evolved since 2014, the dynamics and characteristics of the ecosystem at the time serve as reference for comparison purposes. The New York ecosystem in 2015 had produced 12 unicorns and had around US$6 billion in VC investment (CBInsights 2021; Mulas and Gastelu-Iturri 2016), a closer situation to Tokyo's ecosystem today with nine unicorns and over US$4 billion in start-up investment. New York City is a global city with similar international connections and attractiveness to Tokyo, and its metro area has a population of around 20 million. Both New York and Tokyo are also science and technology clusters as defined by WIPO's Global Innovation Index (see table 1.1). The methodology and limitations of this analysis are explained in detail in Appendix A: Methodology.

Box 2.1: Social Network Analysis

To analyze the Tokyo start-up ecosystem, we employ a social network analysis enriched by comparative data analysis of supportive statistics from other leading start-up ecosystems. The start-up network of Tokyo was built based on the data sources used for this report, which include start-up venture databases and a survey of Tokyo start-up ecosystem founders. These sources serve us to identify the start-up founders, their education and the universities they attended, the main investors and their type (venture capital, angel investor, corporate investor, or financial institution), support infrastructure actors (accelerators, mentors, or incubators), and other skills infrastructure actors present in the ecosystem (coding boot camps and practical entrepreneurial training). We collected data from 3,914 start-ups, thus building a social network of 6,086 entities, which include the start-ups and all other entities connected to the start-ups based on the elements of the ecosystem described in table 2.1: investment, support infrastructure (mentorship, acceleration, and incubation), and skills infrastructure (education and skills training).

In the social network of the ecosystem every entity (start-up, university, investor, accelerator, incubator, and mentor) is represented by a node, which is depicted as a dot in the visual representation of the social network used in the figures of this report. Every existing relationship between these entities (investment by an investor in a start-up, mentorship by mentor of start-up founder, start-up founders who attended and graduated from an acceleration program, and education at a university) is represented by a network link. That link is depicted as a line connecting dots in the visual representation of the social network used in the figures of this report.

To understand the preeminence, influence, and effect of entities in the ecosystem through its social network, we applied social network analysis tools and measurements. In particular, we leveraged to the main kind of measurements to understand the influence and behavior in the network of the different entities of the ecosystem: degree centrality and eigenvector centrality. The first, degree centrality, provides a measurement of the number of other nodes (entities) within the ecosystem to which each node (for example, a start-up, an investor or an accelerator) is directly connected. It does not consider any second-order connections. According to the degree centrality, the importance of an entity depends on the number of connections associated with it. The second measurement, eigenvector centrality, provides a measurement to the wider universe of nodes (for example, entities) that a specific node (for example, a start-up) is connected to. This is done by considering the connectivity of all the nodes (investors, accelerators, incubators, mentors, universities and skills providers) to which this node (for example, a start-up) is connected to. Essentially, this provides a measurement of the network an entity can reach with all its degrees of connectivity. Highly connected nodes within highly interconnected clusters have high eigenvector centrality. In other words, according to these measures, the relevance of an entity depends on how important the other entities are that are associated with it.

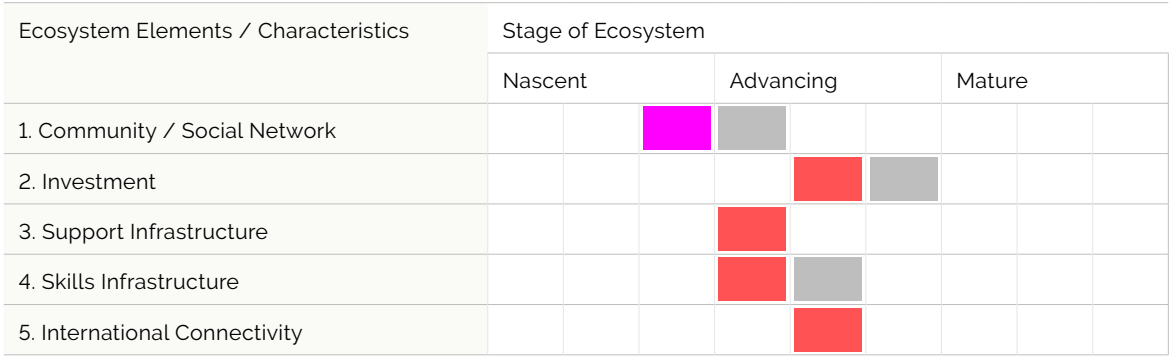
In essence, degree centrality provides a picture of the main clusters in the ecosystem. It is relevant when analyzing the behavior and performance of individual entities or types of entities (for example, how venture capital investors invest in start-ups as compared with corporate investors). Eigenvector centrality provides a picture of who are the connectors in the ecosystem and who can provide access to wider networks of knowledge and resources. With eigenvector centrality, we can understand which entities are more influential in the ecosystem and therefore can be gatekeepers.

The methodology and limitations of this analysis are explained in detail in Appendix A: Methodology.

The evidence from our analysis suggests that the start-up ecosystem in Tokyo is in the advancing stage (see figure 2.1).

The reminder of this section will provide an overview of the Tokyo start-up ecosystem with an overarching analysis of its community and social network. The following sections will analyze the investment, support, and skills infrastructures of the ecosystem with a detailed analysis of the relation of these elements to the ecosystem's community and all other elements.

Figure 2.1:
Development Stage of Tokyo Ecosystem, per Area

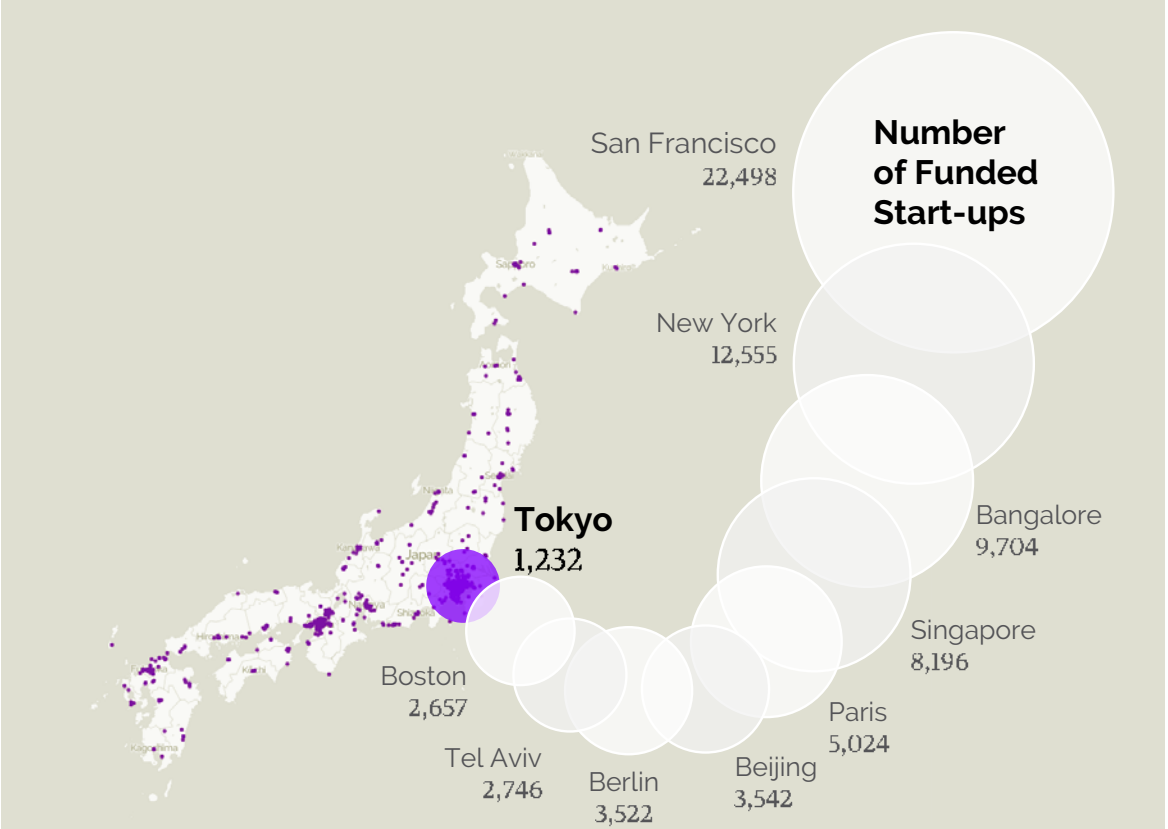


Source: Authors' analysis.
Note: Stages are indicative on the basis of the potential of an ecosystem compared with global peers. Pink represents nascent stage, red advancing stage, and gray means upward trend.

2.2 Overview of Tokyo start-up ecosystem

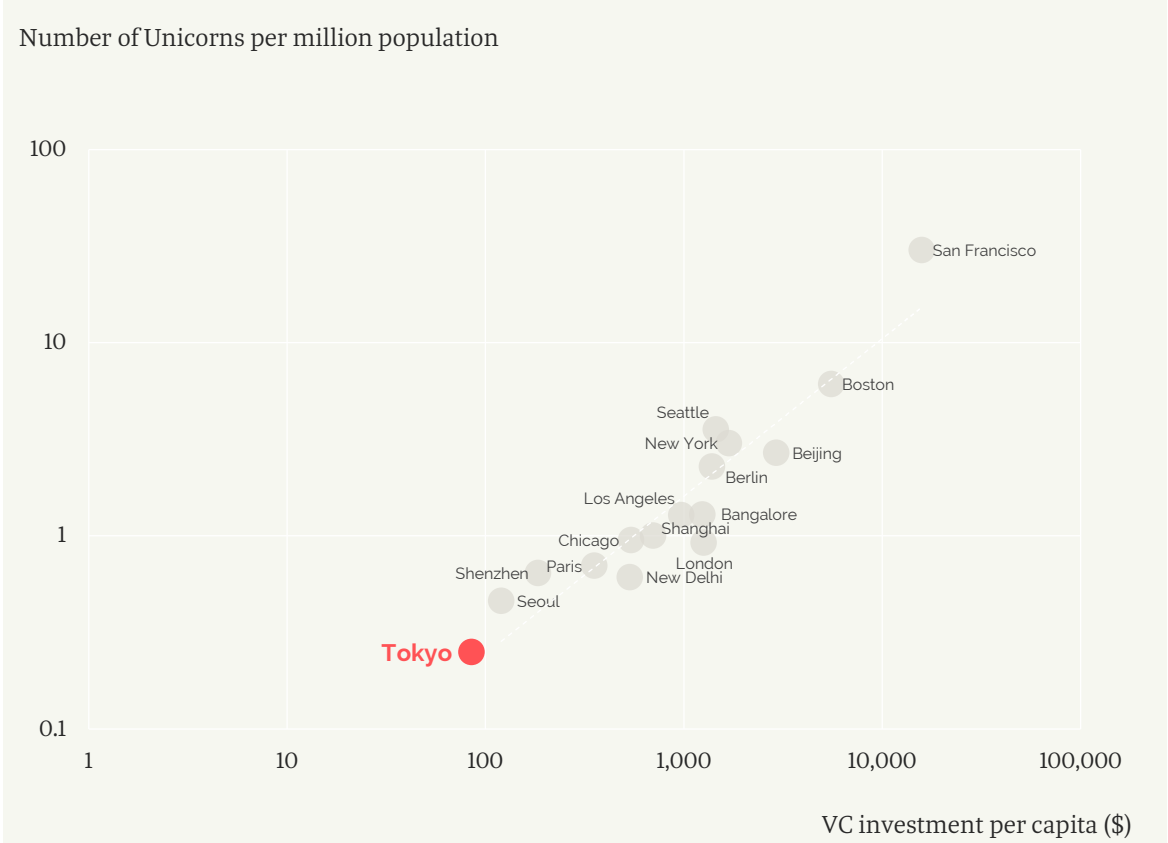
Tokyo start-up ecosystem is home to roughly 6 percent of the global VC investment globally as of 2018, being the 21st largest VC cluster in the world. The ecosystem has been growing steadily, increasing its start-up funding every year except for the year 2020 (see section 3, Investment). Tokyo has produced 9 of the 11 unicorns of the country, 4 of which are deep-tech ventures. Despite this steady growth, Tokyo's start-up ecosystem is relatively small in relation to the leading global start-up hubs. Compared with other global large metropolitan areas, Tokyo has a lower number of internationally competitive start-ups, and both its investment activity and unicorn population falls behind peer cities (see figure 2.2). Tokyo's ecosystem has the lowest unicorn production per million inhabitants of all start-up hubs in metropolitan areas producing nine unicorns and more (see figure 2.3). The ecosystem also attracts 19 times less start-up funding per capita and produces 12 times fewer unicorns per million inhabitants than New York, 16 and 9 times less than Berlin, and almost 1.4 and 2 times less than Seoul (see figure 2.3).

Figure 2.2:
Ecosystems by Number of Funded Start-ups in International Database



Source: Tracxn database, updated to April 2021, https://tracxn.com/.
Note: Start-ups funded per ecosystem reflected in database. Start-up numbers show the population of funded internationally competitive start-ups based on recorded venture capital transactions in the database. It is not a census of the entire population of start-ups in each ecosystem.

Figure 2.3:
Investment per Capita and Number of Unicorns per Million Population in Global Start-up Hubs



Source: For venture capital data — Florida and Hathaway, 2018; for unicorn data - INITIAL, 2021 and CBInsights, 2021; for metropolitan area data — OECD Main Science and Technology Indicators, 2019, https://www.oecd.org/sti/msti.htm.
Note: VC = venture capital.

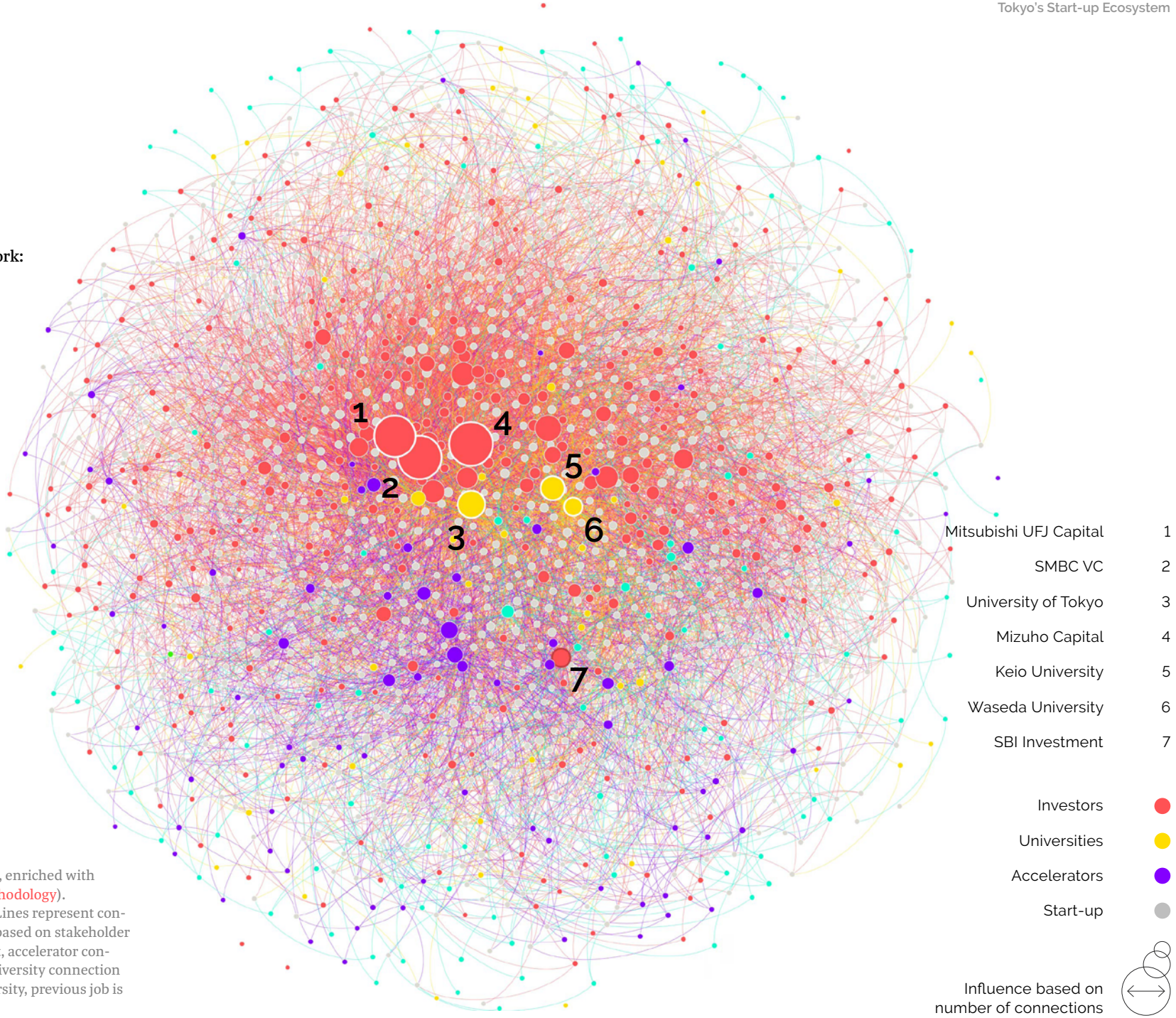
The limited input (VC investment) and output (unicorn companies) resembles Tokyo ecosystem's structure. The ecosystem is still forming and still relies heavily on nonspecialized organizations (see figure 2.4), such as large banks and corporations, that are not designed to cater to or understand the specific needs of growth-oriented start-ups. To that end, Tokyo's ecosystem has not yet developed a sufficient population of specialized actors that can support the ecosystem.[9]

The Tokyo ecosystem's social network shows that the main actors are three established financial groups (Sumitomo Mitsui Banking Corporation [SMBC], Mitsubishi UFJ Financial Group, and Mizuho Bank) together with a large established securities holding group with a VC arm (SBI Holdings) and two of the three top and most prestigious universities in Tokyo — the University of Tokyo and Keio University (see figure 2.4). The three financial groups are dominant within the Japanese banking market, accounting for 59.5 percent of the business[10]. These two universities together with Waseda University are major providers of talent for corporations as well. Diamond Online identified 7,786 students from those three universities who joined 39 top-tier established firms in Japan in 2019 covering sectors including trading conglomerates, financial services, automotive, electronics, information technology, transport, pharmaceuticals, beer, retail, and consulting (Okuda 2020). The results show that 37.2 percent of students employed by these leading firms were from the top three universities listed previously; most top-tier firms rely heavily on the top three universities for talent.

9 For intents and purposes of this report, we use the term *specialized* to refer to funds, accelerators, and other organizations in a start-up ecosystem that are created with the sole purpose of working with start-ups, and they are not part of a corporate, government, or university entity.

10 https://gyokai-search.com/4-kinyu-uriage.html.

Figure 2.4:
Tokyo Start-up Ecosystem's Social Network: Main Influential Actors by Category

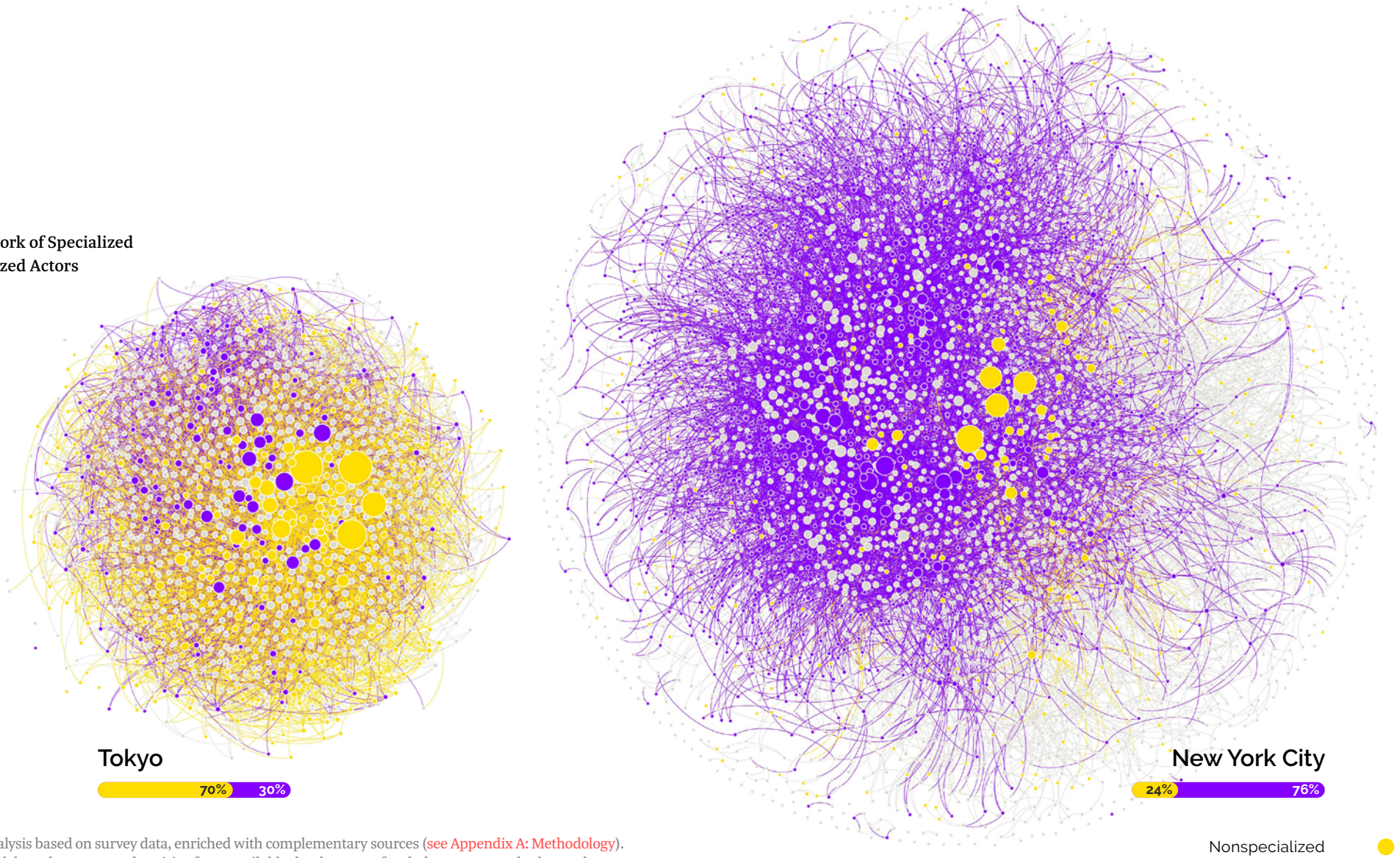


Source: Authors' analysis based on survey data, enriched with complementary sources (see Appendix A: Methodology).
Note: Dots represent ecosystem stakeholders. Lines represent connections between stakeholders and start-ups based on stakeholder role (e.g., investor connection is an investment, accelerator connection is participation in the acceleration, university connection is education of start-up founder in such university, previous job is previous job in such company).

As explained above, New York City's start-up ecosystem provides a good example of the effect of a dominant social network of actors driven by start-ups. The city's start-up scene was anecdotal before 2008, with some relevant start-ups, but without a network of support and minimal resources and infrastructure to help start-ups. At that time, the social network of start-ups was minimal, and there were very limited specialized actors (Mulas and Gastelu-Iturri 2016). Today, New York is the second largest start-up ecosystem in the United States and the third largest ecosystem in the world in producing unicorns and attracting VC funding after the San Francisco Bay area and Beijing (Florida and Hathaway 2018). Its ecosystem's social network is driven by organizations that specialize in supporting start-ups as well. Its main and most influential nodes are all specialized entities with business models driven by start-ups. Banks are not central to the ecosystem, and, instead, VC firms and other specialized financial actors are the most central entities together with accelerators, angel investors, and mentors who are former founders (see figure 2.5).

Tokyo's start-up social network is limited when compared with New York's. Nonspecialized actors, such as banks and corporations, are the most influential actors driving its social network, which limits the ecosystem in resource access and general connectivity. As opposed to specialized actors (such as VCs or accelerators), the nonspecialized actors do not typically cater their services to support the rapid growth of start-ups; they tend to be more risk averse; and they do not provide additional networking to access further supportive resources, such as specialized mentors, angel investors, or other growth-oriented VCs. For instance, banks are more risk averse than VCs and provide debt funding as opposed to equity funding; corporate accelerator programs are aligned with corporate priorities that tend to focus on innovation acquisition. Whereas in New York, specialized entities represent more than 75 percent of the stakeholders supporting the ecosystem, in Tokyo they represent only 30 percent, the reverse image. With only about a quarter of the connections, the specialized social network in Tokyo is limited and not central to the ecosystem — being positioned toward the fringes, which implies less influence and effects (see figure 2.5).

Figure 2.5:
Ecosystem Network of Specialized and Nonspecialized Actors



Source: Authors' analysis based on survey data, enriched with complementary sources (see Appendix A: Methodology).
Note: Social network based on surveyed entities from available databases on funded start-ups and other stakeholders' public information. Tokyo ecosystem includes 6,086 entities and New York's ecosystem 9,168. New York has 1,326 representative support stakeholders (those with more than one connection) with 1,031 being specialized (76 percent) and 313 being nonspecialized (24 percent). Tokyo has 282 representative support stakeholders with 86 being specialized (30 percent) and 196 being nonspecialized (70 percent). Dots represent ecosystem stakeholders. Lines represent connections between stakeholders and start-ups based on stakeholder role (e.g., investor connection is an investment, accelerator connections is participation in the acceleration, school connection is education of start-up founder in such school, previous job is previous job in such company). Colors of lines are based on the connection among specialized and nonspecialized actors with start-ups, and start-ups among themselves.

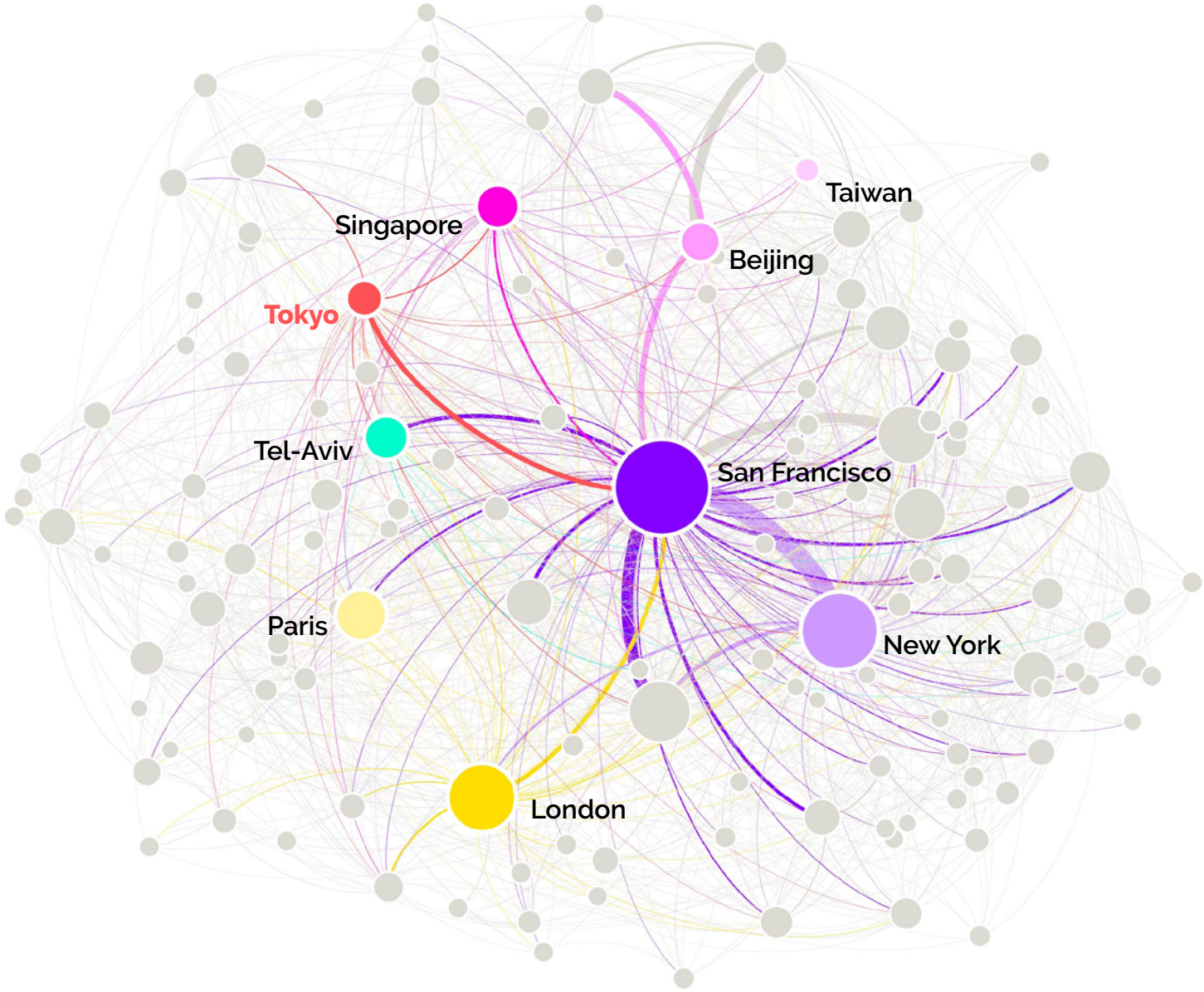
Accelerators in leading start-up ecosystems have a central role in shaping the social network that connects different resources and subnetworks. For instance, in the New York ecosystem accelerators and angel investors are among the most influential actors, creating broader connections among different clusters. In contrast to this, accelerators in Tokyo's ecosystem are relatively small and scattered and do not have a central role. More important, most of Tokyo's accelerator programs are driven or connected to corporate open innovation initiatives, which do not necessarily focus on scaling start-ups. As a result, most accelerators in Tokyo act as independent clusters and do not operate as connectors across the ecosystem and with other ecosystems (Mulas and Qian 2018). In contrast, in New York it is not uncommon for start-ups to have links to multiple accelerators. The result of these connections is that multiple accelerators can help in forming clusters, which are more robust and dynamic than if a single accelerator attempted to be a cluster on its own. However, in Tokyo most accelerators operate as individual clusters themselves. (see section 4, Support Infrastructure.)

The main local universities in New York's ecosystem (New York University and Columbia University) play a critical role as some of the main providers of talent and network connections. However, New York's ecosystem is much more diverse than Tokyo's, having many other universities from outside the city (for example, Harvard, University of Pennsylvania, Massachusetts Institute of Technology, and Stanford) and international ones (for example, Tel Aviv University) playing an influential role (see section 5, Skills Infrastructure). This suggests that Tokyo's ecosystem is limited in its access to talent, relying only on the main universities instead of diversifying and attracting talent from other leading domestic and international educational institutions. Although the three main Tokyo universities have practical entrepreneurship programs in their curricula, these are limited in scale and will take time to produce results. (see section 5, Skills Infrastructure).

Tokyo's start-up ecosystem also has fewer international connections relative to other ecosystems and global start-up hubs. Tokyo's ecosystem attracts a limited amount of international investment compared with other non-Chinese or US start-up hubs.[11] As such, the ecosystem relies heavily on domestic investment. Only 11 percent of start-up funding came from foreign VCs in 2020 — a share that has been between 9 and 12 percent since 2014 (INITIAL 2021). The ecosystem has one of the highest percentages of domestic funding with almost 50 percent of funding for unicorns coming from domestic investment. This lack of international connectivity limits the access to funding needed to scale (from early-stage accelerator funding to large-scale unicorn-size funding) and to access other resources. Tokyo's ecosystem has a moderate degree of centrality internationally. When analyzing deep-tech start-ups, Tokyo is among the top 20 most-connected ecosystems, but it is still behind other leading ecosystems such as New York, London, Paris, Tel Aviv, or Singapore (see figure 2.6). Tokyo's international connectivity is also highly dependent on San Francisco Bay area's ecosystem, the only ecosystem where it has a relevant connection and is not part of a strong regional hub. Different from other leading start-up ecosystems, Tokyo is a net exporter of start-up capital, which suggests that it does not yet produce a sufficient amount of competitive, investable ventures (see section 3, Investment).

11 The large pool of VC funding resources generated domestically by these two ecosystems results in the vast majority of investment being domestic in China and the United States. All other ecosystems in other countries rely on foreign VC funding, primarily from China and the United States, to be able to produce globally competitive start-up hubs that can produce unicorn companies and other niche specialized firms that can compete internationally.

Figure 2.6:
International Connectivity of Deep-Tech Start-ups and Investors Among Start-up Hubs



Source: Authors' analysis based on data from Pitchbook database and World Bank's research, last updated in 2019.
Note: Data here are artificial intelligence, robotics, space technology, and quantum computer. Only the frontier use of those technologies is included. The use of technologies that is accessory (e.g., a noncore use of the technology for the business model) is not included. Start-ups and investors are clustered by location of origin. The dots represent these clusters. The size of the dots is proportionate to the number of start-ups and investors in each cluster. The larger the size of a cluster the larger the number of start-ups (receiving investment) and investors (making investments) a cluster has. The lines show the investment connections between clusters (i.e., investment made and received between clusters). The size of lines is proportionate to the number of investments made and received among clusters. The thicker the line is among clusters, the larger the number of investments made and received among clusters is. This map is built to show relations from country clusters in a gravitational structure. This structure shows clusters closer to other clusters that they have more connections to. Clusters more central in the map denotes the higher number of absolute connections to other clusters and variety of cluster connections (i.e., more connections to more clusters). San Francisco is the most central cluster because it connects to the larger number of clusters with the highest number of connections. The clusters connected to San Francisco create subclusters. Beijing is the largest regional subcluster, with strong connections with Shanghai; Shenzhen; and Hong Kong SAR, China, but also attracting Singapore. New York and Boston also create sizeable subclusters that connect multiple regions. London and Paris create smaller regional subclusters.

Geographically, the Tokyo ecosystem has two main clusters formed around two main stations with high connectivity and close to the city and national railway networks, with two major supporting subclusters (see map 2.1). The main clusters are Shibuya and the Marunochi-Nihonbashi (around Tokyo station). Shibuya is the larger cluster with the highest variety and concentration of start-ups and ecosystem actors. This cluster is formed around the Shibuya station and actively supported by Shibuya City and the main developer of the area (Tokyu Corporation), which has attracted key companies to the area, such as the accelerator Plug and Play Tech Center, developed its own innovation hubs for start-ups, and attracted large innovation and technology companies such as Google and Google for Startups Campus to the area. The Marunochi area concentrates a large proportion of the financing actors of the ecosystem and is home to fintech start-ups. Mitshubishi Estate has supported this cluster with its Otemachi Building, hosting a fintech lab (FINOLAB) and attracting start-ups, support actors and corporate partners to be located in this building and its surrounding area. Marunochi is also home to Tokyo metropolitan area start-up support programs and the Aoyama Startup Accelerator Center. Nihonbashi is connected to the Marunochi, but it has a larger concentration of biotech firms with its larger and more affordable space for this kind of ventures. Mitsui is the developer supporting Nihombasi. The subclusters are formed around business districts with high concentration of corporations: Shinjuku and Toranomon. Shinjuku is a major business district and is the home of the Tokyo Metropolitan Government.

Map 2.1:
Start-up Clustering in Tokyo by District

Source: Authors' analysis based on survey data, enriched with complementary sources (see Appendix A: Methodology); access map at http://japan.data593.com/TOYKO_CLUSTER_ST.html.
Note: Cluster colors are based on size: red shows the largest concentration, followed by light red.

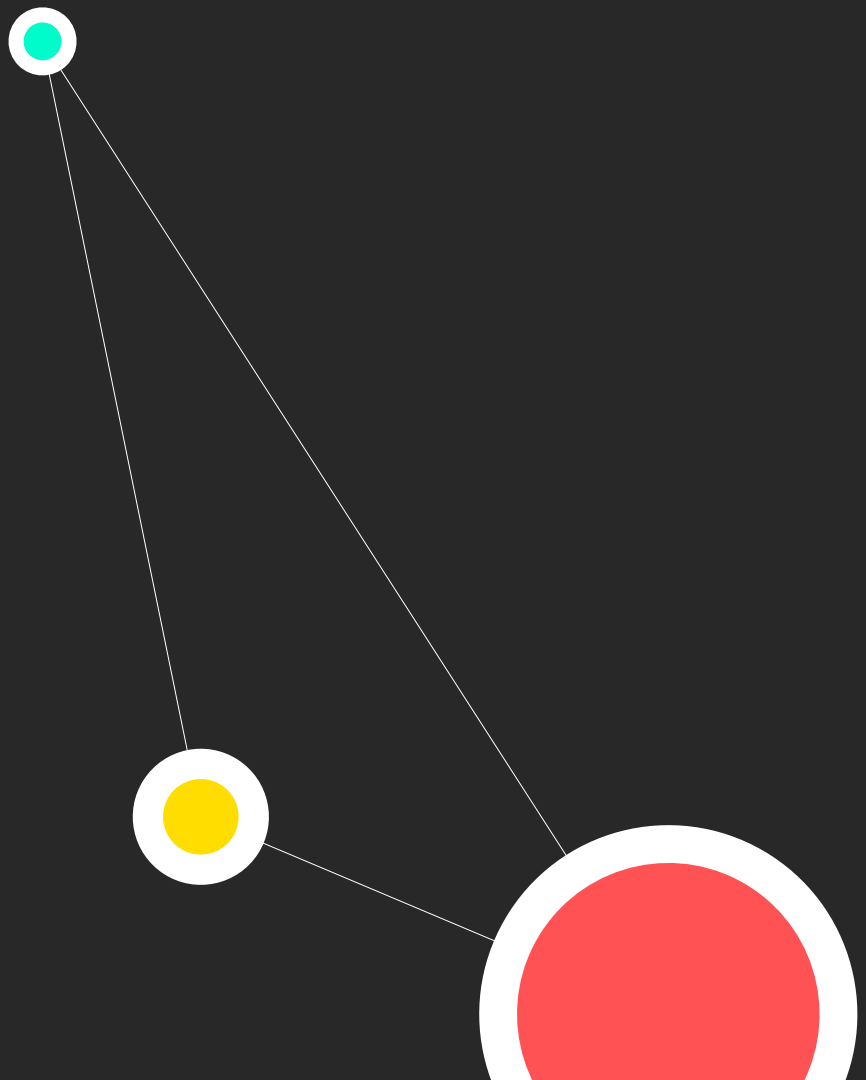
Toranomon also has a large concentration of corporations, and it is closely connected with the government and administrative district of Tokyo in Kasumigaseki and Nagatacho. Mori Building Company has an active role developing the start-up ecosystem in Toranmon with a focus on corporate and open innovation, and it has been attracting start-up hubs to support corporate innovation such as the Cambridge Innovation Center.

Key *takeaways*

1. **Tokyo's start-up ecosystem is at an "advancing" stage and not ranked among the global ecosystem leaders.** Tokyo has notable assets that makes it competitive, for example, a substantial amount of investment activity, access to world-class universities, and corporate and government involvement. Yet it has not reached critical mass to produce sufficient competitive global start-ups, and it has a domestic orientation. Tokyo has lower overall VC investment levels and a smaller unicorn population compared with other large global metropolitan areas. The ecosystem still relies heavily on nonspecialized organizations, such as large domestic banks, that are not designed to work with start-ups and tend to have a more domestic mindset. The disproportionate reliance on these actors suggests that Tokyo has not yet developed a sufficient population of specialized actors that operate with the sole purpose of helping tech entrepreneurs to start and grow companies to international competitive levels.

2. **Tokyo has a small specialized start-up community of stakeholders, limiting the ecosystem's growth orientation and international competitiveness.** Tokyo's ecosystem has a limited set of growth-oriented stakeholders. Angel investors, independent accelerator programs, and VCs are limited and not yet central to the ecosystem. Instead, the ecosystem is dominated by financial institutions, corporate investors, and corporate-led accelerators. Best performing ecosystems rely on a large community of actors, who at their core, are oriented to start-ups and who produce a critical mass of globally competitive start-ups. These start-up actors not only provide their expertise, knowledge, and funding to start-ups directly, but they also serve as connector hubs to access additional talent, knowledge, and networks of domestic and international mentors and funding that start-ups need as they grow.

3. **Tokyo's start-up ecosystem also has less international connectivity relative to other ecosystems and global start-up hubs.** Tokyo has a limited number of international and global stakeholders oriented to start-ups. Only one global accelerator has a permanent presence in Tokyo (Plug and Play), and its local program is primarily affiliated with corporate sponsors. Tokyo's ecosystem attracts a limited amount of international investment compared with other non-Chinese or US start-up hubs. As such, the ecosystem relies heavily on domestic investment and resources (for example, knowledge), increasing the bias toward domestic focus and limited growth. In 2020, 11 percent of start-up funding in Tokyo came from foreign VCs and since 2014, the highest amount has been 12 percent. Regarding funding for unicorns in particular, 50 percent has come from domestic investors. Tokyo's international connections are limited and highly reliant on San Francisco Bay area's connections.



Section 3

Investment

3.1 Specialized start-up investment is underdeveloped and highly domestic

3.2 Access to funding is limited and does not match the needs of start-ups to grow

3.3 Tokyo ecosystem is a net exporter of investment, attracting little foreign capital

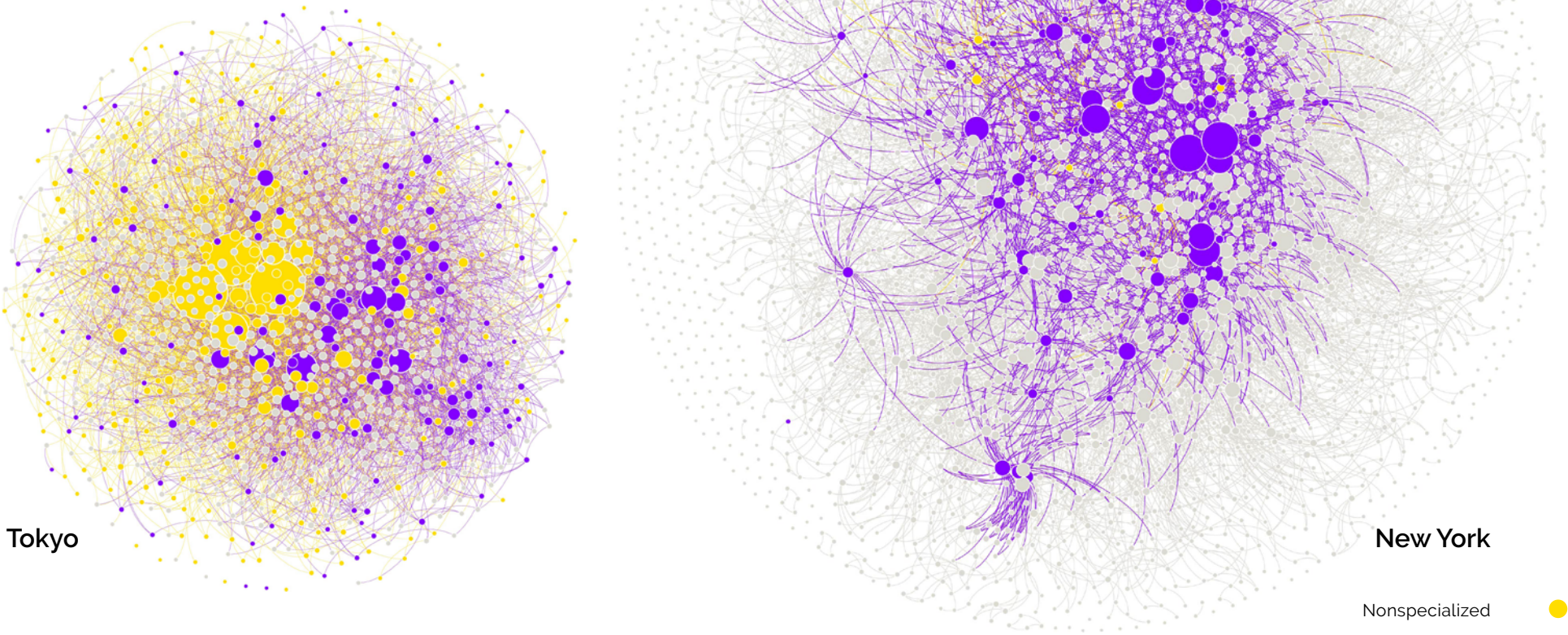
3.4 Corporates and universities have a strong presence in the ecosystem, but immaturity of investment can distort the market

3.1 Specialized start-up investment is underdeveloped and highly domestic

Tokyo's start-up ecosystem is home to one of the 25 largest venture capital (VC) clusters in the world (see section 2, Tokyo's Start-up Ecosystem), and the start-up investment has grown steadily since 2012 with a compound annual growth of 26 percent until 2019 when it reached US$4.8 billion (¥525 billion) (INITIAL 2021). The overall VC investment levels in Japan are still limited when compared with other ecosystems in both GDP intensity and per million residents (see figure 1.3 and figure 2.3 in previous sections).

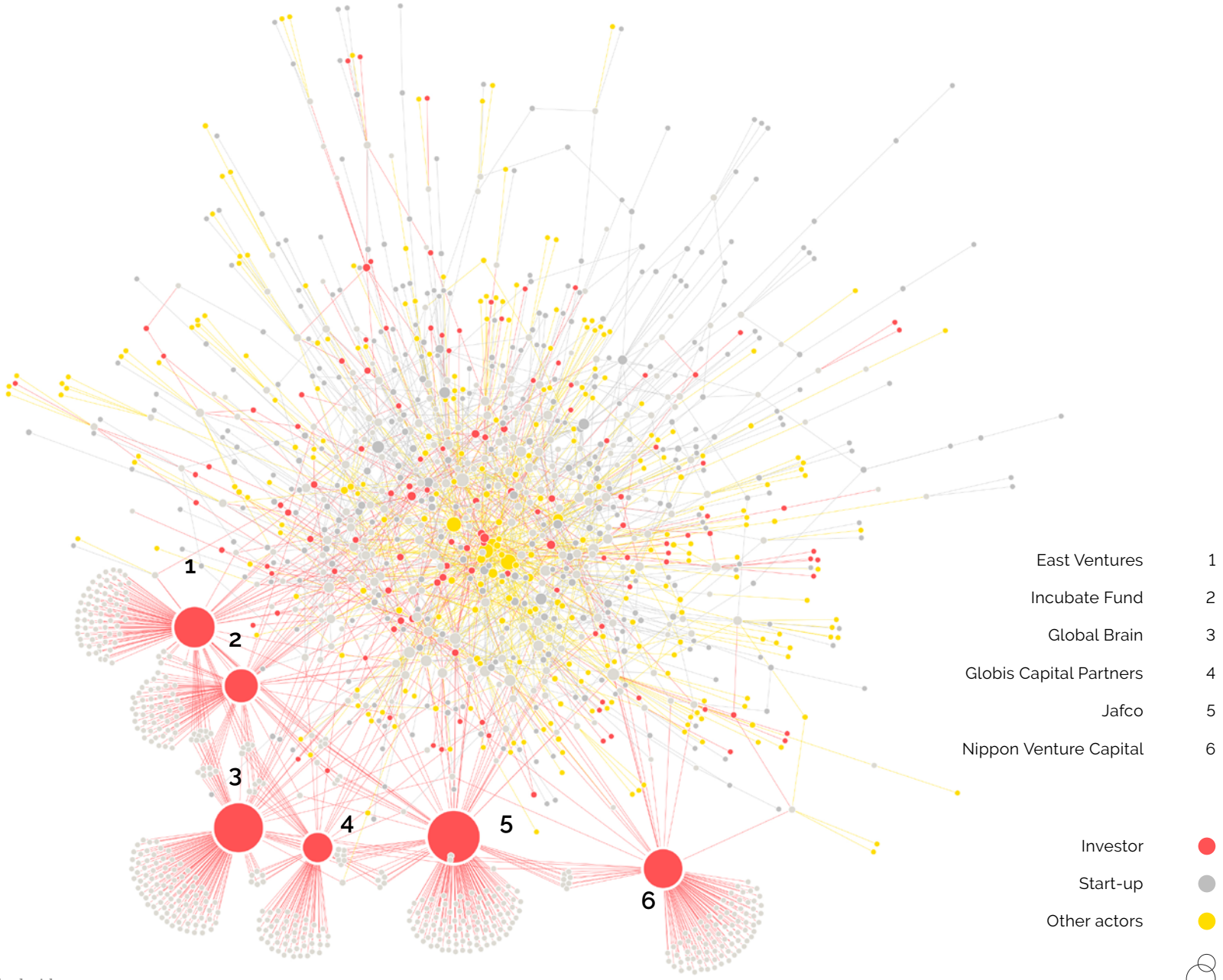
Tokyo's funds that are specialized in start-up investment are still underdeveloped and are primarily domestic in nature. Additionally, there are few foreign funds that have invested in Japan's start-ups. In contrast to leading start-up ecosystems, funding entities in Tokyo's ecosystem are predominantly traditional financial institutions and corporations, such as entities that are not specialized in working with start-ups. In this ecosystem analysis, we also find that these financial institutions are typically the most influential in the ecosystem and also have the highest centrality measures. In New York, specialized funding actors, such as venture capital firms and angel investors, have the higher centrality (with nonspecialized funding actors, such as traditional banking, being marginal); the opposite is true in Tokyo where the ecosystem is dominated by nonspecialized actors (see figure 3.1).

Figure 3.1:
Ecosystem Network of Specialized and Nonspecialized Investment Stakeholders



Source: Authors' analysis based on survey data, enriched with complementary sources (see Appendix A: Methodology).
Note: Dots represent ecosystem stakeholders. Categories of stakeholders follows legend color code. Lines represent connections between stakeholders and start-ups based on investment.

Figure 3.2:
Top Tokyo Independent Venture Capital Investment Networks

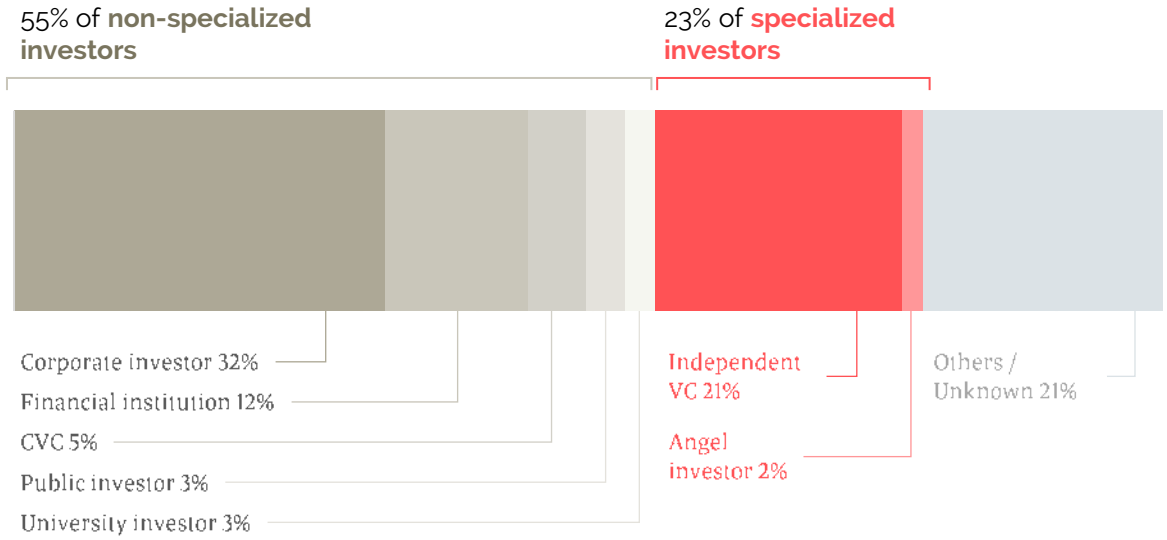


Source: Authors' analysis based on survey data, enriched with complementary sources (see Appendix A: Methodology)
Note: Lines represent investment connections.

VC firms in Tokyo are loosely connected with the larger ecosystem and are not primary investment firms. VCs in Tokyo operate separately from the largest investors of the ecosystem such as financial institutions and corporations, and they generate limited subnetworks of investment comprising early-stage start-ups (see figure 3.2). The results imply that independent VCs are not fully integrated within the larger ecosystem and operate as a quasi-independent network.

Angel investors, the other source of the ecosystem's start-up specialized funding, are emerging, but they are limited in numbers and influence (see section 5, Skills Infrastructure). Together, independent VC funding and angel investment represents only 23.2 percent of all start-up funding in the Tokyo ecosystem, whereas nonspecialized actors (financial institutions, corporations, and government-led funds) covered the rest. Of those, corporations lead investments in start-ups with 32.4 percent, followed by financial institutions at 12.4 percent (see figure 3.3). This picture contrasts with other leading ecosystems, such as the United States, where VC funds and specialized investment entities for start-ups account for 75 percent of all start-up funding activity, with the remaining 25 percent comprising corporate and government entities.

Figure 3.3:
Breakdown of Start-up Investor in Japan 2020 by Type

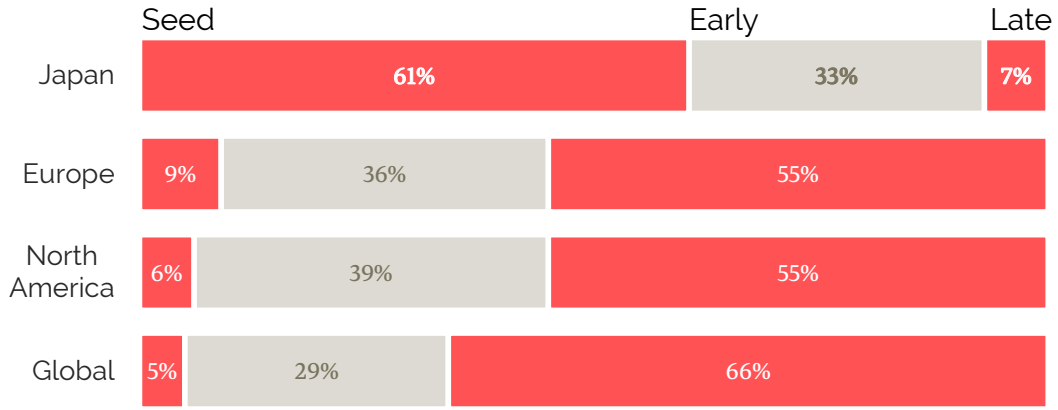


Source: Authors' analysis based on INITIAL, 2021.
Note: CVC = corporate venture capital; VC = venture capital. Corporate Investor includes mergers and acquisitions (M&A) deals, which is assumed to account for approximately 5 percent of corporate investor activity. The calculation is based on an average M&A deal of US$5 million and an average of 50 M&A deals per year. The breakdown is based on investment amount (rather than number of investors).

3.2 Access to funding is limited and does not match the needs of start-ups to grow

This structure of the ecosystem's investment activity has important implications for Tokyo's start-ups. Investment in the ecosystem is disproportionately concentrated in early stages, and it is small in ticket size when compared with other ecosystems. In the United States and Europe, VC investment is proportionately higher per stage, with more than 50 percent in later stages; in Japan the opposite is true with more than 60 percent in seed stage and less than 7 percent in later stage (see figure 3.4). This gap in late-stage funding poses a significant limitation for start-ups to scale and compete globally as they have to rely on more uncertain and slower mechanisms, such as the Mothers market (discussed later in this section), than on specialized investment actors (such as VCs and angels) to access funding.

Figure 3.4:
Distribution of VC Investment Stages (%)

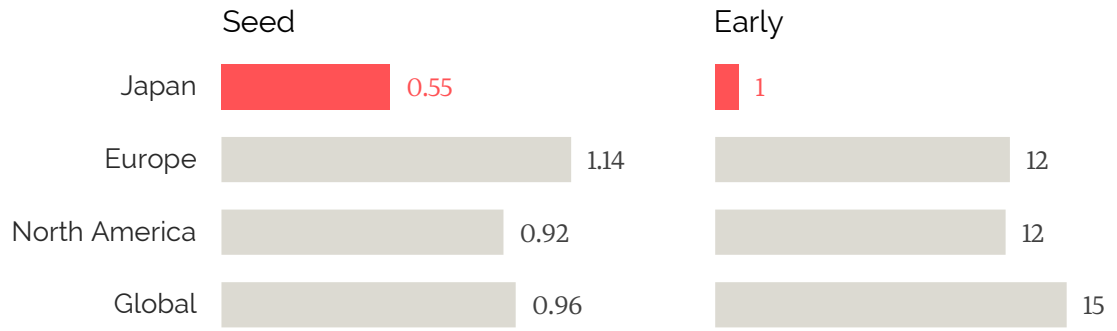


Sources: For Europe and global — Teare 2021a and 2021b; for North America — Teare and Azevedo 2020; for Japan — INITIAL, 2021
Note: VC = venture capital. For benchmarking purposes, stages have been unified to the international standard followed by CBInsights: seed stage for deals below US$3 million; early stage for deals between US$3 million and US$5 million and late stage for deals above US$5 million, INITIAL data are based on funding received by start-ups per investment series, which have been adapted to follow Teare and Azebedo (2020) and Teare (2021a and 2021b) value criteria.

Similarly, compared with other mature ecosystems the amount of funding for deals is smaller, especially in the growth stages. The average round for seed stage in Tokyo is about half of the global average, as well as the average levels in the United States and Europe. The early-stages funding is even smaller, with an average deal size 12 times lower than the United States' and Europe's average. There are no similar reported data for later stages in Japan, but given that Japan has a disproportionate concentration of investment in early stages (see figure 3.5), this trend is likely to be replicated or even augmented in larger investment stages.

Specialized funding actors combine investment with mentoring and connecting to other resources. In mature ecosystems, conditions for investment from these actors are designed to cater to start-ups needs, with incentives aligned with the rapid growth and scale-up needed for the different types of ventures. However, in Tokyo the limited amount of specialized VC and angel funding prevents many start-ups from accessing these needed resources. This impediment is particularly relevant at the early and middle stages of start-up growth, where the founders need more mentoring and brokering from ecosystem gatekeepers to grow their companies. Investors that do not understand the needs of start-ups (for example, by taking a large size of equity that impedes further investment rounds) or that force an early initial public offerings (IPO) preclude ventures from pivoting their business models in an agile way and from scaling up (Venture Enterprise Center 2020).

Figure 3.5:
Average Deal Size per Investment Stage Category, US$ Millions



Sources: For Europe and global — Teare, 2021b and 2021c; for North America — Teare and Azevedo, 2020; for Japan — Venture Enterprise Center, 2020.
Note: Investment stages have been unified to the international standard followed by CBInsights. Those categories are seed stage for deals below US$3 million, early stage for deals between US$3 million and US$5 million, and late stage for deals above US$5 million. VEC classifications may differ as the value of each state referred to is not disclosed. Instead, VEC methodology refers to the stage of the company, which may not correspond with CBInsights' classification, especially for early and late stages. For benchmarking purposes, VEC classifications of early stage and expanding stage have been merged into early stage.

Because of this structure, Japanese start-ups tend to pursue small and early IPOs as their primary exit strategy, thereby leveraging the Tokyo Stock Exchange market of the high-growth and emerging stocks (Mothers) market, which only requires ventures to demonstrate growth-potential[12] and has no restrictions for size or business category (JETRO 2020). A study by Japan's Ministry of Economy, Trade, and Industry (METI) shows that 65 percent of exits in Japan are IPOs whereas the number is only 7 percent in the United States (METI 2019). Mothers market has been a proven friendly tool for start-ups to raise funding, but it has not yet supported the growth at the same level that specialized investment actors have in global leading ecosystems, particularly for rapid scale-up. Data obtained from the Japan Exchange Group shows that while the number of IPOs has increased in the past decade, the amount raised by IPOs has declined (Japan Exchange Group n.d.). In 2020, the average amount raised per IPO was US$9 million. In the past, only 2 of the 42 IPO companies reached a US$1 billion post-money valuation, namely Sansan at US$1.33 billion and Freee at US$1.09 billion. In the United States, start-ups tend to remain private longer, sometimes never going public. Of the 82 start-up IPOs in the United States in 2019, more than one-third were valued at US$1 billion or more. High-profile tech companies such as Uber and Lyft even surpassed a US$10 billion valuation before their IPOs (see table 3.1). Such billion-dollar exits enhance the ecosystem's global visibility and attract attention from international investors and talent.

12 For an IPO in the Mothers market, ventures are required to describe their business and the reasons for the growth potential or to meet a minimum profit of ¥100 million (approximately US$1 million) and showed a track record of growth before and after reaching such profit. See Tokyo Stock Exchange, New Listing Guidebook Mothers (Tokyo: Tokyo Stock Exchange 2019), https://www.jpx.co.jp/english/equities/listing-on-tse/new/guide/tvdivq0000002g9b-att/bv22ga0000001ugk.pdf.

Table 3.1:
Start-up IPOs 2019, United States versus Japan

	# Start-up IPOs in 2019	Avg. valuation (US$ billion)	Avg. valuation of top 10 IPOs (US$ billion)	Ratio of US$1 billion + exits	Ratio of US$10 billion + exits
United States	82	2.8	20	33%	5%
United Kingdom	11	0.5	—	—	—
Japan	42	0.1	0.56	5%	0

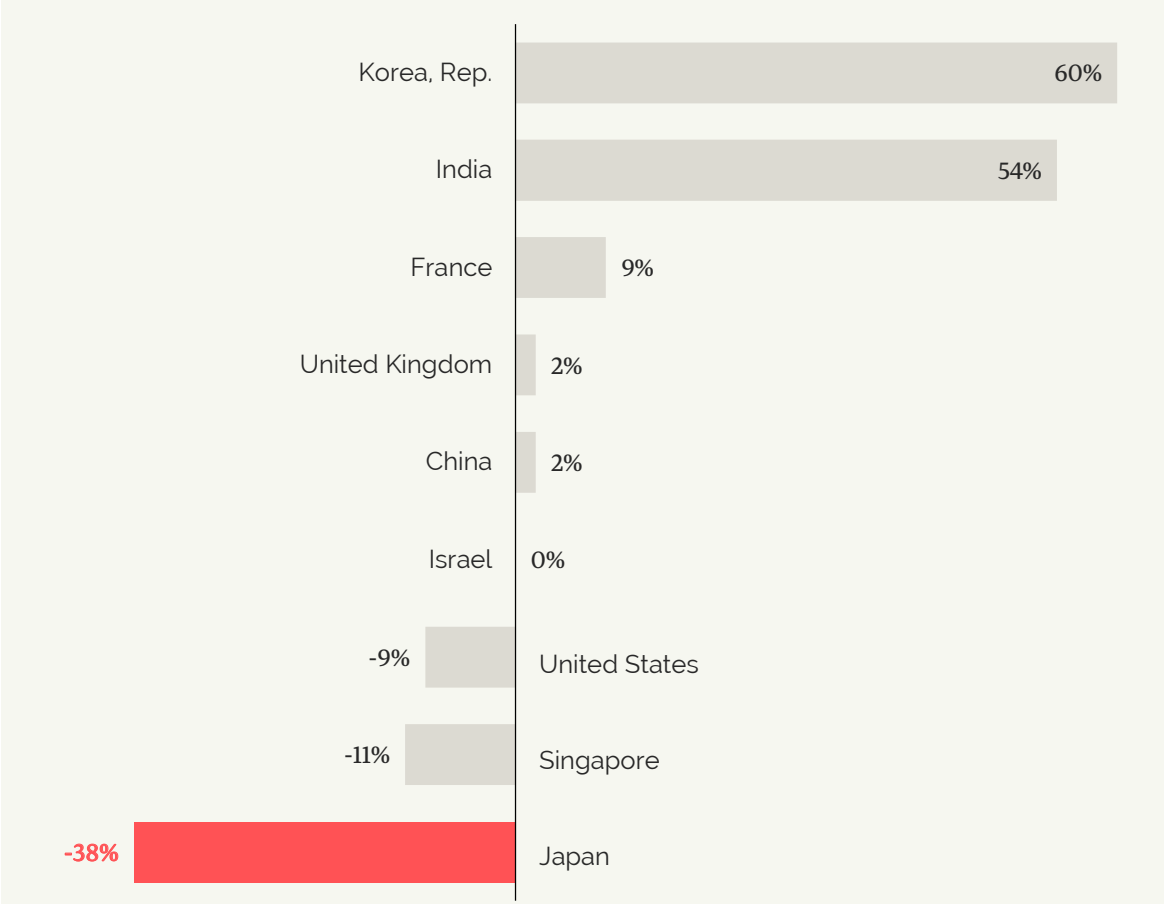
Sources: For United States — NVCA 2020 Yearbook, data provided by PitchBook (post valuation), National Venture Capital Association, 2020; for United Kingdom — Tech Nation (IPO valuation), Tech Nation, 2021; for Japan — INITIAL Japan Startup Finance Report 2019 (IPO valuation), INITIAL, 2021.
Note: — = not available; IPO = initial public offering. The average IPO valuation is estimated based on the research of INITIAL. Traditionally, Japanese start-ups would carry out IPOs after Series B or C rounds and reach a valuation of around ¥10 billion (around US$100 million). See INITIAL (2021).

The Mothers market could serve as a way to access growth investment for start-ups if it develops further. However, for the Tokyo ecosystem to reach a similar scale as its global start-up ecosystem peers, it will require to supplement the Mothers market with growth investment from specialized actors. Thus, it will need to further develop and enlarge the VC funding available at all stages, particularly for larger scale-up start-ups and for a diversity of actors with more international connections.

3.3 Tokyo ecosystem is a net exporter of investment, attracting little foreign capital

Tokyo ecosystem is a net exporter of capital with the lowest number of net foreign investments in unicorns among countries that are home to such companies (see figure 3.6). Japan receives the lowest number of inbound investment deals in unicorns except for the United States and China, who are home of the largest domestic VC markets in the world and are two of the few exceptions that do not need to rely on knowledge, funding, and networks from abroad. This gap could be a consequence of the ecosystem not producing a sufficient quantity of quality investable ventures, as suggested by the immaturity and underdevelopment of the investment market, or of a market entry limitation to foreign investors.

Figure 3.6:
Investment Balance Gap in Unicorns (%)
(Investment Received from Other Countries by Japan versus Investment Made from Japan to Other Countries)



Sources: CBInsights, 2021a, February data; author's analysis.
Note: The percentage is calculated by the number of investments: one investor equals one investment.

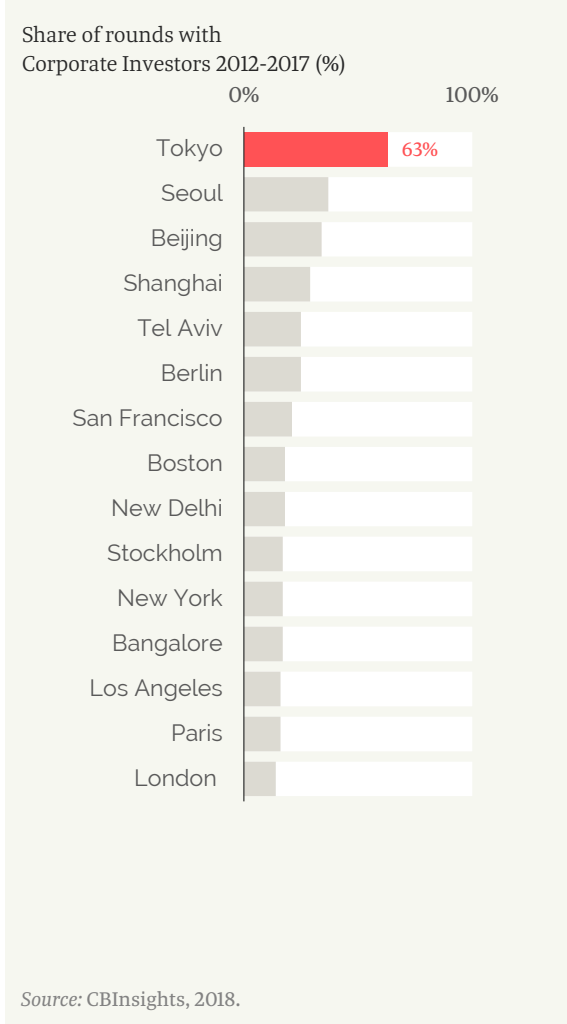
3.4 Corporates and universities have a strong presence in the ecosystem, but immaturity of investment can distort the market

Tokyo has one of the largest presences of corporate investors, among global ecosystems, with more than 60 percent of start-up rounds having a corporate investor (for example, a corporation or corporate venture capital [CVC]). This percentage is almost double that of ecosystems such as Seoul and Beijing and almost three times more than San Francisco, Boston, and New York (see figure 3.7). Corporate investment in start-ups is growing globally, increasing more than 200 percent since 2014 (CBInsights 2019a). Tokyo's strong presence of corporations presents an opportunity for further integration in its ecosystem.

Corporate venture investors provide the largest share of investment in the ecosystem, responsible for one-third of all VC funding (see figure 3.3). And yet, corporate VCs are a complement rather than a replacement to standard venture funds. With CVCs currently playing a central role in the ecosystem, one could argue that they are not functioning in the most ideal position. Typically, CVCs operate under different incentives than do standard VC firms, focusing on maximizing the direct value that the start-up can provide to the parent corporation, rather than growth and financial returns. By definition, corporate CVC teams tend to concentrate on a relatively small number of mid- to late-stage start-ups that are highly relevant to the mother company's core business area. To that end, when they make investment decisions, they consider synergy effects in addition to pure financial returns expected of that start-up. The social network of Tokyo CVCs reveals this exact pattern. CVCs invest primarily in a limited amount of start-ups, often doing so in collaboration with other CVCs (see figure 3.8). As such, whereas CVCs are indeed relevant and necessary players in Japan's ecosystem, more VCs operating independently of corporations are needed to ensure that more specialized, growth-oriented funding is reaching start-ups.

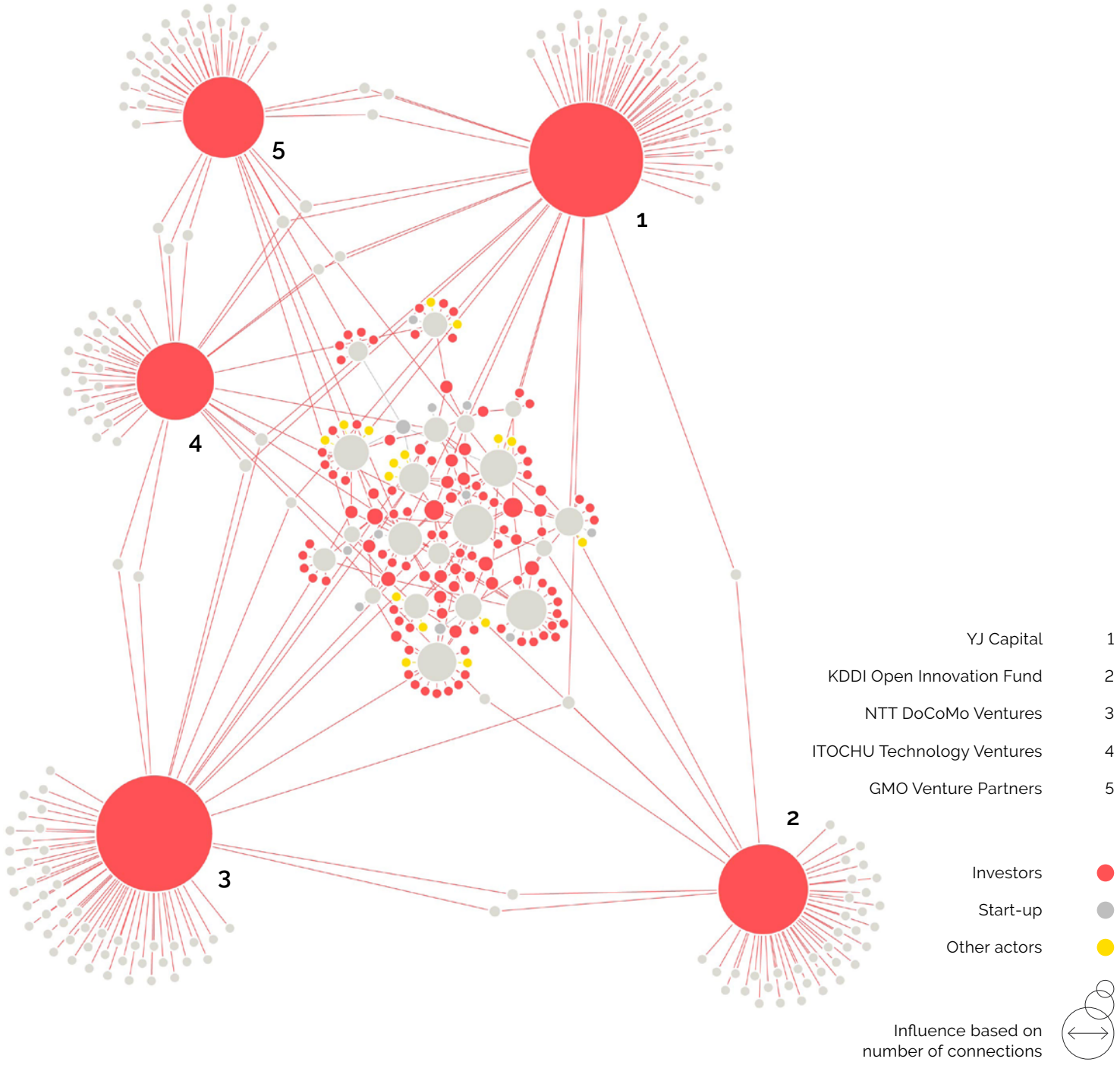
Even with the large share of corporate investment in Tokyo's ecosystem, a considerable amount of this CVC funding is deployed overseas. Of the CVCs in Japan with more than ¥10 billion (approximately US$90 million) under management as of 2020, three are focused solely on overseas investment, representing 15 percent of the overall CVC funding; others have a mixed portfolio of domestic and international holdings (Toyo Keizai 2019). Last, corporate investors tend to overprice start-ups (Masahiro et al. 2019). Since 2014, average CVC deals have been between 30 and 90 percent higher than VC deals globally (CBInsights 2019a). With one-third of the funding of the Tokyo start-ups being led by corporate investors, this tendency to overprice distorts the funding market in Tokyo and makes it more difficult for specialized VCs and angel investors, including foreign investors, to enter the market and operate.

Figure 3.7:
Distribution of VC Investment Stages



Source: CBInsights, 2018.

Figure 3.8:
Top Corporate Venture Capital (CVC) Network in Tokyo Ecosystem



Source: Authors' analysis based on survey data, enriched with complementary sources (see Appendix A: Methodology).
Note: Lines represent investment connections.

Generally speaking, university-linked funds in Japan are classified in two categories. The first group includes public universities that set up funds through a public program led by Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT) and METI. Through this program, the universities formed VC arms to commercialize university R&D. As of 2020, Tokyo ecosystem's most preeminent universities have created funds valued at US$1.7 billion, with the largest being deployed by the University of Tokyo (see table 3.2).
The second category is composed of public and private universities linked to independent VC funds. This group includes the University of Tokyo Edge Capital Partners (UTEC) and private universities Keio and Waseda. UTEC is the largest university-affiliated fund launched thus far. UTEC, founded in 2004, was created as an independent VC associated with the University of Tokyo with approximately US$500 million in assets under management; it focuses on seed and early-stage start-ups associated with academic institutions that include the University of Tokyo. In addition to UTEC, Tohoku University, the University of Tokyo, Kyoto University, Osaka University, Keio University, and Waseda University also have all launched VC funds (see Appendix B: Data).

Traditionally, the role of universities in a start-up ecosystem has been to provide talent and technology. In Japan, universities are now expanding the scope of their involvement to focus on engineering technological breakthroughs and commercialization. From an ecosystem perspective, such efforts are a boost for start-ups, particularly deep-tech start-ups that tend to be rooted in advanced academic research (see section 5, Skills Infrastructure).

Table 3.2:
University-Affiliated Funds in Japan (¥ Billion)

Vehicle Name	Associated University	Total Fund Size	1st Fund Size	2nd Fund Size	3rd Fund Size	4th Fund Size
University of Tokyo Edge Capital Partners (UTEC)	University of Tokyo	54.3	8.3	7.2	14.57	24.3
UTokyo Innovation Platform Co. Ltd (UTokyo IPC)	University of Tokyo	50.0	25.0	25.0	n.a.	n.a.
Kyoto University Innovation Capital (Kyoto-iCAP)	Kyoto University	34.1	16.0	18.1	n.a.	n.a.
Osaka University Venture Capital (OUVC)	Osaka University	22.0	12.5	9.5	n.a.	n.a.
TOHOKU University Venture Partners (THVP)	Tohoku University	18.1	9.6	8.5	n.a.	n.a.
Keio Innovation Initiative	Keio University	14.8	4.5	10.3	n.a.	n.a.
(Fund of Funds)	Waseda University	2.0	2.0	n.a.	n.a.	n.a.

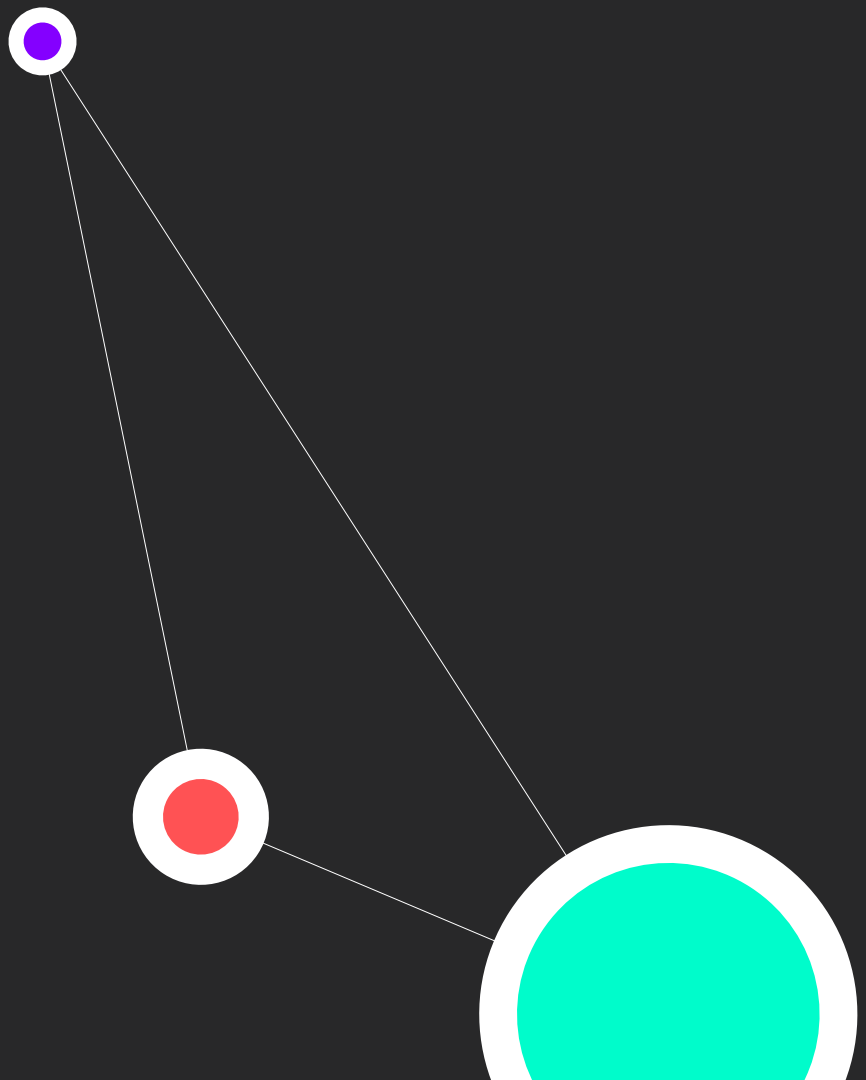
Sources: University of Tokyo Edge Capital Partners official website, https://www.ut-ec.co.jp/; UTokyo Innovation Platform official website, https://www.utokyo-ipc.co.jp/; Kyoto University Innovation Capital official website, https://www.kyoto-unicap.co.jp/; Osaka University Venture Capital official website, https://www.ouvc.co.jp/; Tohoku University Venture Partners official website, https://thvp.co.jp/; Keio Innovation Initiative official website, https://www.keio-innovation.co.jp/; Waseda University press release, https://www.waseda.jp/top/news/62087.
Note: n.a. = not available.

Key *takeaways*

1. **Tokyo start-up ecosystem has a limited start-up specialized funding, which has not yet matured to later stages.** Whereas Tokyo is the 25th global hub for VC investment, the ecosystem lags other global leaders in size and sophistication of investors as well as access to foreign funds. Perhaps most notably, traditional financial institutions are some of the most influential actors in the ecosystem. This finding suggests that, indeed, these institutions are influential and contributory, yet by definition they are not designed to invest in start-ups. Thus, there is a higher likelihood that these institutions may not support the ecosystem growth by only funding established start-ups that can already access bank finance. High-growth start-ups require equity financing with strategic support, which is not typically provided by these financial institutions. As a result, Tokyo's specialized funding is highly concentrated in early stages, limiting the growth path for new start-ups to reach globally competitive sizes. When Tokyo start-ups reach a point at which they require later-stage funding, they are faced with few local options. As such, they may turn to an IPO too early, sacrificing growth potential in the process.

2. **Tokyo's ecosystem has one of the highest participations of corporation investment, which poses limitations in the advancing stage of the ecosystem.** The participation of corporations as investors is a notable trend, which presents a mixture of advantages and disadvantages. On one hand, CVC activity is an asset for the ecosystem. Corporations have access to markets and expertise that start-ups can benefit from and provide additional funding. Universities also have a relevant presence on the investment ecosystem, participating in VC investments. On the other hand, CVC and universities involvement is not a replacement for standard VC funds, as they do not generally operate with a start-up focusing on growth. Tokyo still lacks a robust VC community that can cope with the needs of the ecosystem potential. These growth-oriented VCs are essential for reaching a critical mass of high-growth start-ups in advancing stages of ecosystems. Whereas nonspecialized funding actors can expand the ecosystem when it has reached a mature stage, such a high concentration of nonspecialized funding in an advancing stage in Tokyo contributes to limiting growth-oriented funding through inflated valuations and skimming the most attractive market opportunities.

3. **The preeminence of nonspecialized domestic-oriented funding actors limits the capacity of the ecosystem to produce global competitive start-ups.** The Tokyo ecosystem faces an unique challenge. On one hand, it has mobilized capital from traditional financial institutions and engaged corporations in funding as well, which could be an advantage once the ecosystem achieves global scale. Additionally, government- and university-backed funds are also included in this cohort of nonconventional funders. On the other hand, the growth-oriented start-up funding, VCs, and funding from early-stage angels and accelerators are limited and operate at the fringes of the ecosystem's social network. International, more seasoned mid-stage and large-stage funds are barely present in Tokyo, resulting in minimum late-stage funding options. This has produced an ecosystem where the large part of funding relies on nonspecialized actors that often lack a growth strategy and have very limited international connections for creating a critical mass of globally competitive start-ups.



Section 4

Support Infrastructure

4.1 Support infrastructure is minimal and consists primarily of corporate programs

4.2 Accelerator programs are small and mostly driven by corporate priorities

4.3 Angel Investors and mentors' networks are small, and few have founding experience

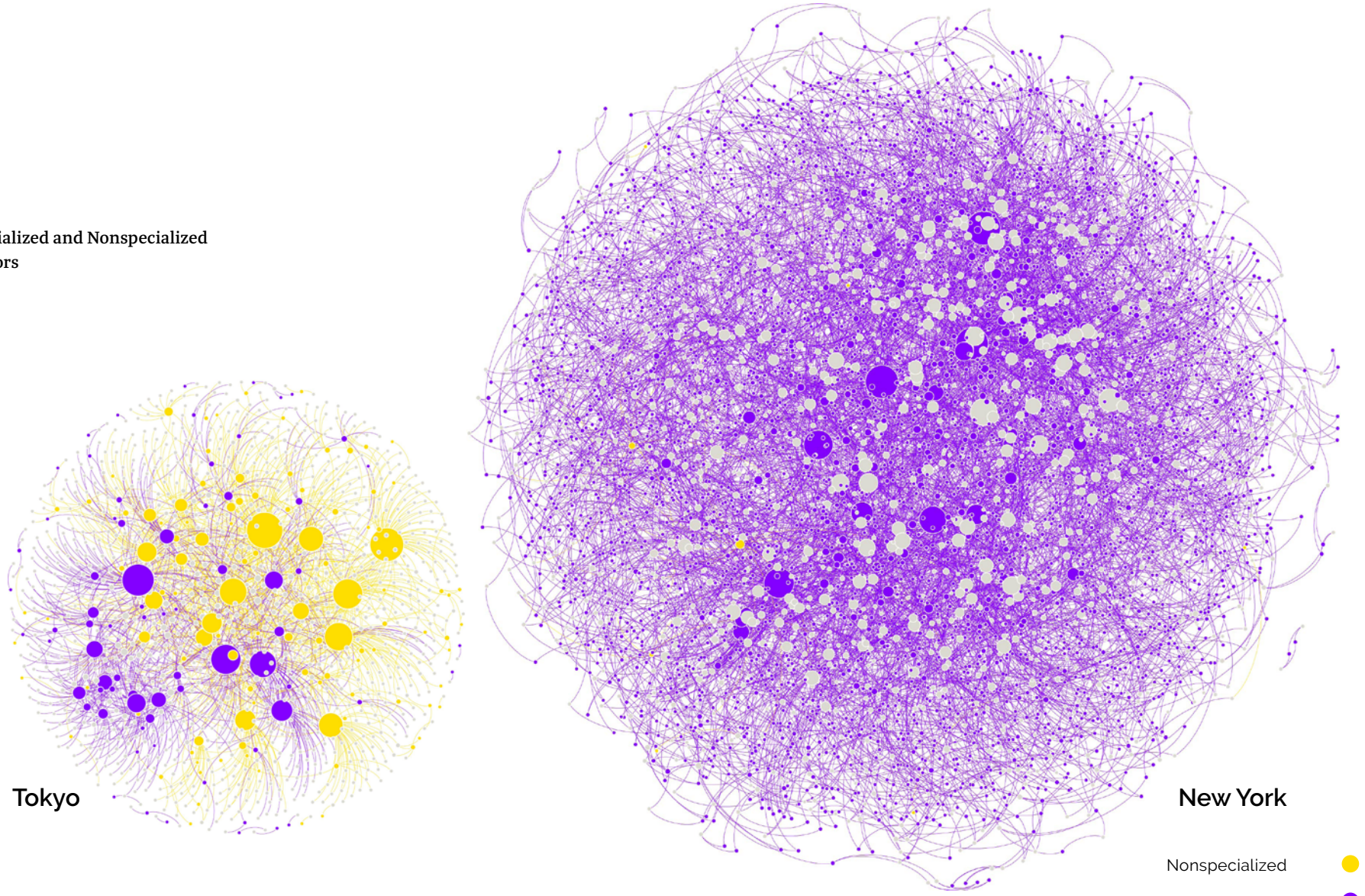
4.4 Start-up community events are emerging, but they are still small and operate with a domestic focus

4.1 Support infrastructure is minimal and consists primarily of corporate programs

The supporting infrastructure in Tokyo's ecosystem is still underdeveloped. The ecosystem has myriad small support programs linked to corporations and very few specialized accelerator programs. Nonspecialized actors are not typically designed for start-up growth, and they cater to different objectives, such as corporate ones. In this sense many of the nonspecialized actors serve as scouting tools for innovation acquisition and absorption from corporates, more than for start-up growth. The mentors provided by nonspecialized actors are typically corporate-oriented with little experience in growing ventures outside a corporate environment, and their networks are not necessary connected with growth-oriented funding actors. Moreover, at the ecosystem level there are few independent mentors who previously were founders. Angel investors with previous experience as founders are emerging but their effects are still limited and they operate in isolation from each other, not yet having developed an ample network. Start-up community events are emerging in the ecosystem as well, but they are small and have a domestic orientation.

Specialized support infrastructure actors have limited influence in the ecosystem with no major centrality. High centrality and influence of specialized support infrastructure actors is common in leading start-up ecosystems like New York. In this as well as in other leading ecosystems, investors and mentors with previous founding experience (many of whom have conducted successful start-up exits) together with specialized accelerators with strong mentor networks and specialized investors dominate the ecosystem, having the highest centralities (see figure 4.1).

Figure 4.1:
Ecosystem Network of Specialized and Nonspecialized Support Infrastructure Actors



Source: Authors' analysis based on survey data, enriched with complementary sources (see Appendix A: Methodology).
Note: Dots represent ecosystem stakeholders. Lines represent connections between stakeholders and start-ups based on acceleration, mentor relation, or attendance to event.

The lack of development of support infrastructure limits founders' access to practical knowledge and networks (Aspen Network of Development Entrepreneurs and Village Capital 2013; Aspen Network of Development Entrepreneurs, I-DEV International, and Agora Partnerships 2014; Roberts et al. 2016). Mentors with start-up experience, together with specialized accelerator programs are necessary for start-ups to succeed and grow from the seed and early stages (Qian, Mulas, and Lerner 2018). Moreover, support infrastructure programs, such as accelerators, play a critical role in connecting global ecosystems. These links can help ensure that knowledge, expertise, resources, and networks are shared between countries and regions, and they are especially important for more domestic-oriented ecosystems, like Tokyo (Mulas and Qian 2018).

Accelerators are perhaps the best example of support infrastructure, as they combine various services that aim to support start-ups. Whereas many accelerators provide funding as well, the real difference with accelerators is that they also offer access to coaching and training, mentors, and partnerships, and, in general, they are hubs for the ecosystem. In doing so, accelerators frequently play multiple roles: early-stage investor, skills provider and mentor, connector, and general supporter of the ecosystem. There are many types of accelerator support programs; having the proper accelerators creates the most positive results (see box 4.1).

Box 4.1: Types of Accelerator Support Programs

Type	Description	Effect
Pre-accelerator	Events, meetups, competitions, camps, and other preacceleration support programs (e.g., short accelerator programs of fewer than 3 months) all play a role in onboarding start-ups into the ecosystem. Often, these entities create and uphold social networks in the ecosystem.	Entrepreneurs gain exposure to the start-up ecosystem and can familiarize themselves with different institutions and individuals that have an influence on it. Entrepreneurs can also receive preliminary feedback on their business ideas, introductions to potential cofounders and early-stage employees.
Accelerators	Full-fledged acceleration programs (3–6 months) are arguably the most robust experiences for start-ups. They often combine a mixture of investment and standard incubation services (e.g., desk and office space) along with access to mentors and partners and a structured program to guide entrepreneurs in the early days of defining their product market fit, of approaching investors, of making preliminary hires, and of building their marketing strategies, among other strategic areas. Accelerators can also serve as a powerful node in the ecosystem's social network functioning as a gathering point for different stakeholders.	Start-up teams get a holistic range of support services and also get embedded in a larger network of investors, entrepreneurs, corporations, and other key groups. Accelerators can serve as the initial investor in new start-ups as well as the connector between institutional investors and start-ups. Accelerators can also serve as a seal of approval for start-ups. Being affiliated with a well-known accelerator brand can be a mark of quality for the start-up in the eyes of potential investors, partners, and employees.
Start-up studios	Venture studios are similar to accelerators in that they provide a range of support services to early-stage businesses, however, they differ in how business ideas are sourced. Typically, venture studios' management teams will identify a series of business opportunities that they believe they can capitalize on and subsequently build start-ups internally that will explore opportunities. Once a start-up has matured, the studio team will recruit executives to run the company fulltime.	Studios can achieve effects similar to what accelerators achieve, however a key difference between the models is how they source new ideas. Accelerators will solicit applications from young start-ups; studios will create companies internally and then recruit teams to run them.
Corporate innovation	Corporate innovation centers can serve as the source of new product ideas for corporations, wherein employees pitch and design new ideas aligned with a core business objective. Additionally, consulting firms such as Dream Incubator can serve as an adviser to corporate innovation teams, helping the parent entity spin out companies that it designs.	These entities and initiatives can help launch start-ups that are aligned with a corporation's core mission. In doing so, the start-ups will likely also come into the market with a strategic investor or partner from day one, with the corporation often playing one or both of these roles.
Additional services	Although not providing as holistic an experience as proper accelerators or other support programs, other entities — such as those that help entrepreneurs and their teams recruit employees, provide interim CEOs, and other key positions,[a] — can also be useful as the start-up scales up. These companies may also serve as partners for accelerators, studios, and corporate innovation teams.	Start-ups receive very targeted support, focused on particular areas of their business.

a. For an example or such entities, see ForStartups at https://forstartups.com.

4.2 Accelerator programs are small and mostly driven by corporate priorities

Accelerators and support programs in Tokyo are small and primarily affiliated with corporations. Of the 155 accelerators and support programs included in this analysis, 50 percent were affiliated with corporations, 25 percent were public programs, and 25 percent were specialized accelerators. Among the specialized accelerators most are small and have few connections between each other. In contrast to that, most of New York's support programs operate independently of corporations and the government and have a central role in the ecosystem. Additionally, independent accelerators also often play the role of enabling connections between specialized programs and mentors (see box 4.1).

This preeminence of corporate accelerators in Tokyo may limit the ability of the support infrastructure to produce a larger number of growth ventures. Corporate programs tend to mainly focus on start-ups that can add immediate value to the corporation itself, rather than helping start-ups achieve scale as a venture capital (VC) or specialized accelerators. These programs often begin with a pitch contest where a small number of start-ups that produce products or provide services that are aligned with the corporation's mission are selected to join the accelerator. The products of these open innovation programs are often ideas for new products and services that are then further developed by the corporation and not necessarily a start-up. When a start-up is developed, the corporation may exit it through mergers and acquisitions to further develop the product or service internally, instead of generating an independent venture that will create a new business. Whereas corporate accelerators also support growth ventures, those tend to be in fewer.

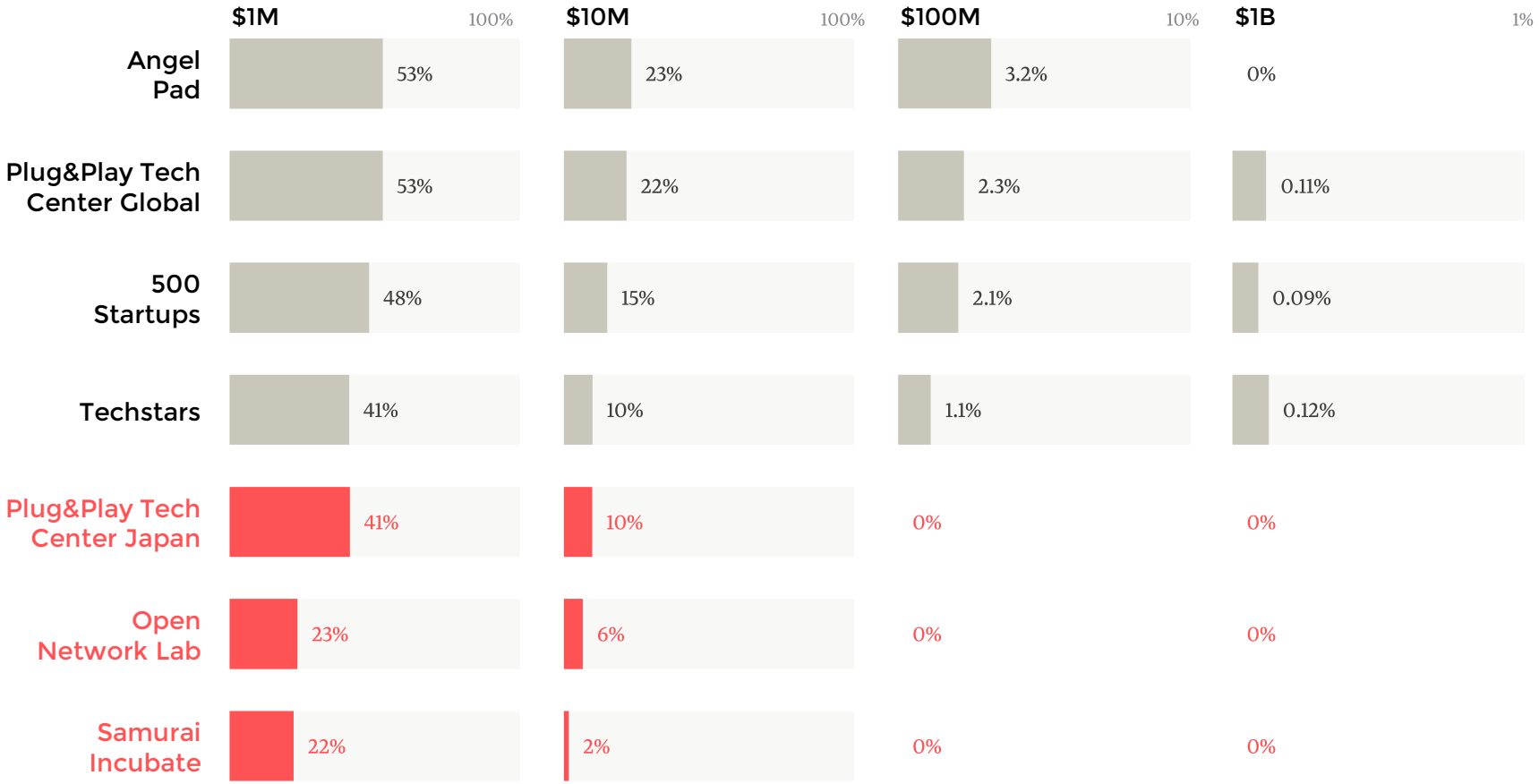
Corporate accelerators and support programs are complementary to the start-up ecosystem overall, as is the case in leading global ecosystems with growing corporate open innovation and investment schemes such as San Francisco, New York, Berlin, or Tel Aviv. However, in Tokyo where the specialized support infrastructure is comparatively limited, the relative dominance of corporate accelerators may impede the development of the critical mass of stakeholders and resources, for example, experienced founders, angels, mentors, investors, and start-up employees, that are needed to generate a sustainable, growing pipeline of globally competitive start-ups.

Accelerator programs in Tokyo have few international connections and experience in generating globally competitive ventures. Except for Plug and Play, no large international accelerator programs are operating in Tokyo. Moreover, there are no Tokyo accelerators out of the 2019 Crunchbase top-100 accelerator list,[13] in comparison with global leading ecosystems such as San Francisco (8), London (6), New York (4), Berlin (3), Singapore (3) and Seoul (2). All of these ecosystems also have accelerators that have generated unicorns (see table 4.1). [14] Absent a layer of competitive, globally connected accelerators, start-ups in Tokyo will have limited opportunities to compete in the global market when compared with start-ups in other leading ecosystems.

13 See https://about.crunchbase.com/blog/100-startup-accelerators-around-the-world/.

14 In Kobe, 500 Startups has a program of short duration, and Techstars has recently developed a short training program in Tokyo. Both programs are publicly funded. Information based on interview conducted by authors.

Table 4.1:
Comparison of Selected Accelerators on the percentage of start-up raised funding of the following amounts (%)



Sources: Accelerator websites: 500 startups, https://500.co/; Techstars, https://www.techstars.com/; AngelPad, https://angelpad.com/; Plug and Play Tech Center Global, https://www.plugandplay-techcenter.com/; Plug and Play Tech Center Japan, https://japan.plugandplaytechcenter.com/; Samurai incubate, https://www.samurai-incubate.asia/; Open Network Lab, https://onlab.jp/en/; Pitchbook database, https://pitchbook.com/, and Tracxn database, https://tracxn.com/.
Note: $ = US$; B = billion; M = million.

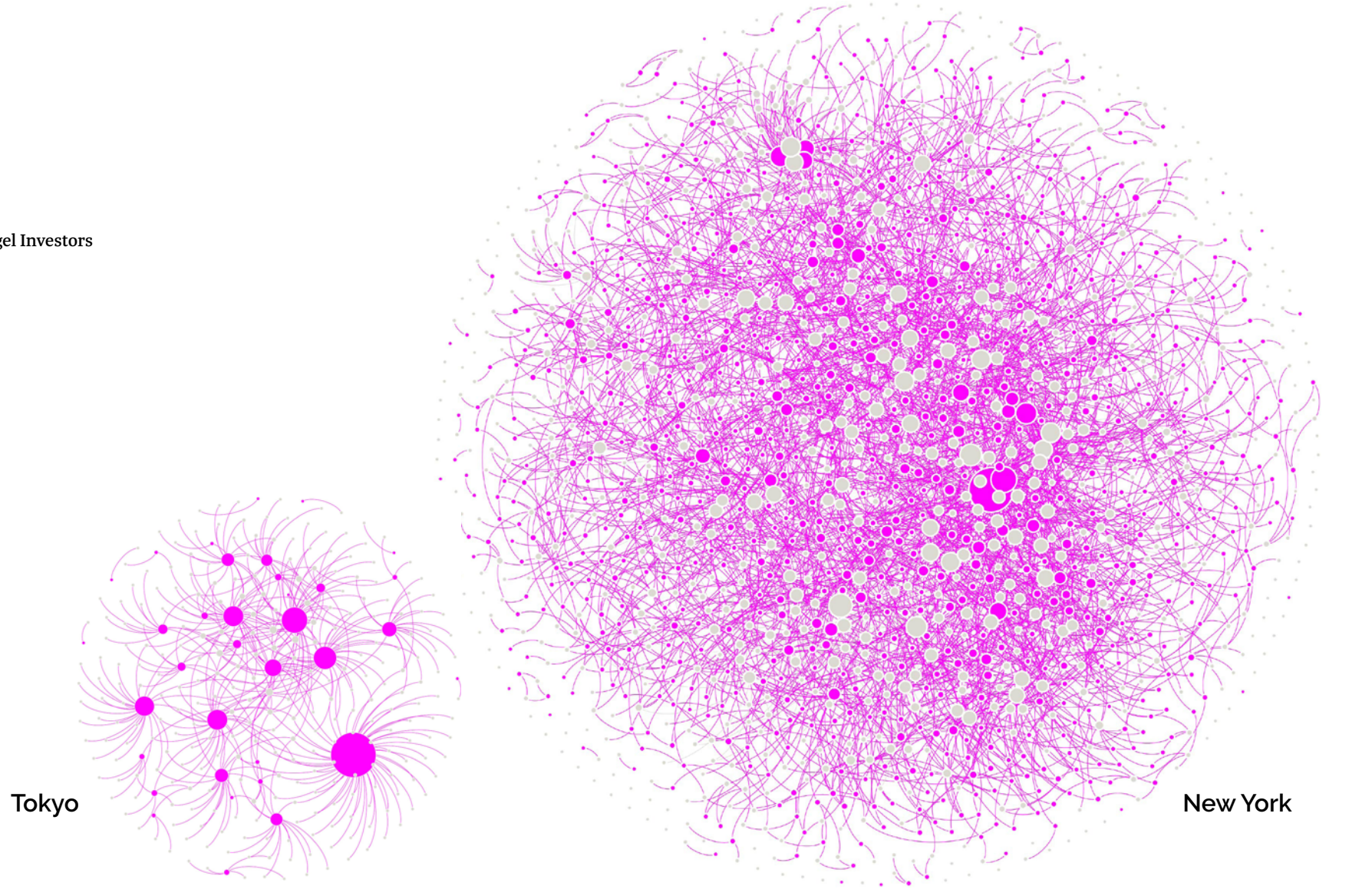
4.3 Angel investors and mentors' networks are small, and few have founding experience

Angel investors and mentors with start-up experience are critical for start-ups as well as for the ecosystzem's success. They provide the practical advice and know-how into venture development and serve to connect new founders with funding and other resources from the local ecosystem and abroad (Kerr, Lerner, and Schoar 2010; Lerner, Schoar, Sokolinski, and Wilson 2010). A successful start-up ecosystem usually contains a number of super angels and super mentors who have a large start-up investment portfolio and extensive relevant connections with talent, corporations, and so forth. In Tokyo, Chiba Kotaro is one of the prominent angel investors in Japan. He has invested in more than 60 start-ups and 40 VC funds and has established two funds: the Chiba Dojo Fund and the DRONE FUND.

However, compared with New York, the Tokyo ecosystem's angel and mentor community is still developing (see figure 4.2). For instance, there are no Japanese angel investors in the top 20 most influential angels in the world. Whereas Tokyo is the 21st largest VC hub globally, it is the 76th in angel and seed investments (Florida and Hathaway 2018). Angel investment represented less than 2 percent of total funding received by start-ups in 2020, as compared with 18 percent in the United States (INITIAL 2021; Sohl 2020). Angel deals in Japan are also relatively smaller than in other leading global ecosystems with well-formed networks. According to the Venture Enterprise Center survey in 2019, about 82.7 percent of start-ups reported that they received less than US$460,000 (¥50 million) investment from angel investors (Venture Enterprise Center 2020), while the median angel deal size is US$580,000 (about ¥62 million) in the United States. See PitchBook (2020).

These subnetworks are starting to connect with each other, but the overall ecosystem's mentor and angel network is still relatively small. In comparison, globally competitive ecosystems such as New York have large centrally connected networks of mentors and angel investors supporting the overall ecosystem (see figure 4.2). Also, it is worth noting that few foreign angels operate in the Tokyo ecosystem, again demonstrating that most of the resources available for Japanese start-ups come from within Japan.

Figure 4.2:
Ecosystem's Network of Angel Investors



Source: Authors' analysis based on survey data, enriched with complementary sources (see Appendix A: Methodology).
Note: Dots represent ecosystem stakeholders. Lines represent connections between stakeholders and start-ups based on investment or mentorship.

4.4 Start-up community events are emerging, but they are still small and operate with a domestic focus

Start-up ecosystems operate as a community, where knowledge spillovers and access to resources flow through interconnected networks (Mulas et al. 2018). Community-building events serve as one of the intermediates that link different players in the ecosystem and strengthen coordination among stakeholders.

Tokyo has been seeing the emergence of a growing number of tech and start-up events as its ecosystem has grown. These events come in various formats, including small ones like local meetups and start-up weekends, as well as bigger ones such as national competitions, hackathons, and conferences (see table 4.2). For example, the Infinity Ventures Summit (IVS) has been organized by the Japanese VC firm Infinity Venture Partners since 2007, and it is one of the most popular technology conferences in Japan. Twice a year, the conference gathers executives, investors, and start-ups for two days at different locations nationally. Reaching about 1,000 participants in its last online conference, IVS has become one of the biggest internet business communities in Japan. Similarly, the Industry Co-Creation (ICC) Summit is another influential event focusing on connecting industries. The ICC Summit has invited 800 attendees to its most recent private event in 2021.

The ecosystem has also attracted some international brands. Slush Tokyo entered Japan in 2015 and is the most international start-up event in Japan. In 2019, the last edition of Slush Tokyo, more than 6,000 attendees, 600 start-ups, and 300 media representatives gathered from more than 70 countries and regions. Now Slush

Table 4.2:
Selected Start-up and Tech Events in Tokyo

Event name	Start year	Participants in most recent event	Topic
Infinity Ventures Summit (IVS)	2007	600	Internet
B Dash Camp	2011	750	Technology start-ups
Industry Co-Creation Summit (ICC)	2016	900	Co-Creation
Slush Tokyo (stopped in 2019)	2015	6,000	Start-up and tech

Source: Masahiro et al., 2019.

Tokyo has evolved and given birth to a new local community brand–Bark. American entities such as the online newspaper *TechCrunch* and the competition experience Startup Weekend also have local events in Tokyo. However, the number and scale of community-building events in Tokyo's ecosystem is small when compared with other global ecosystems. As mentioned previously, except for Slush Tokyo, the top tier start-up and technology events in Tokyo have fewer than 1,000 participants (see table 4.2 for selected tech events). To put in context, New York's largest software developer event, Developer Week New York, drew more than 3,000 participants in the past year.

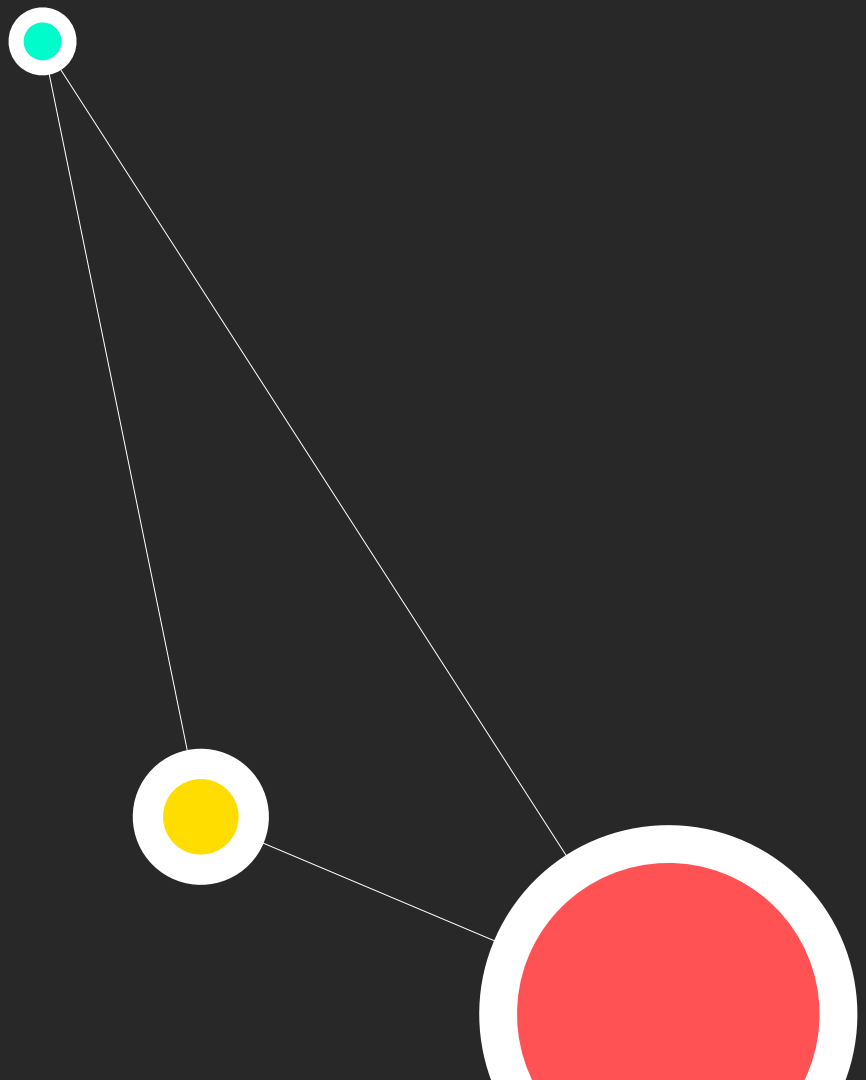
In contrast to global start-up ecosystems, Tokyo does not host any super events that attract a critical mass of international participants. For instance, every year Lisbon hosts Web Summit, the largest technology conference in the world, which brings in up to 70,000 attendees from more than 100 countries. Likewise, the Startup Grind conference in Silicon Valley (i.e., San Francisco Bay area) drew about 10,000 participants from around the world in February 2020. Additionally, the Echelon Asia Summit, a large tech event in Singapore, has 15,000 attendees from more than 30 countries each year. These global events facilitate an international exchange of talent and resources for start-up ecosystems and can enhance an ecosystem's ability to attract foreign talent, knowledge, and resources.

Key *takeaways*

1. **Tokyo support infrastructure of start-up specialized actors is limited with no global international program with permanent presence.** Tokyo's population of accelerators is still small and primarily features corporate accelerators, which tend to operate in very specific industries and do not serve as hubs for the ecosystem. In contrast, there are very few specialized accelerators operating independent of corporation, and the predominance of corporations in this area have put constraints on how effectively those accelerators can operate. Moreover, the few independent accelerators are small in scale and influence.

2. **Angel investors and mentors with successful start-up experience are limited and have little international experience.** Angel investment communities are small and growing in Tokyo, and there are several examples as well of highly active angel investors. For example, the most prominent angel investor identified in our database has equity in at least 60 start-ups and 40 VC funds, and it has established two funds. However, this population has yet to become a noted force in the ecosystem, and Tokyo lags other global metro areas in overall angel investments.

3. **Tokyo is still attracting large start-up events and international connectors that link the ecosystem to other leading global hubs.** Like accelerators, events are also critical for shaping culture and networks within ecosystems. There are some entrepreneurship events taking place in the Tokyo ecosystem. However, relative to those held in other large metropolitan areas, Tokyo's events are still small and are not gathering a critical mass of relevant stakeholders. Whereas Slush Tokyo did bring a sizable tech crowd together, it ceased operations in 2019. As such, the ecosystem currently lacks a community of accelerators, events, and other entities that can play both a gathering as well as a galvanizing role.



Section 5

Skills Infrastructure

5.1 Skills infrastructure ecosystem is dominated by institutions with limited start-up skills development

5.2 The ecosystem's formal skills infrastructure is highly local and concentrated in Tokyo, with little attraction of international talent

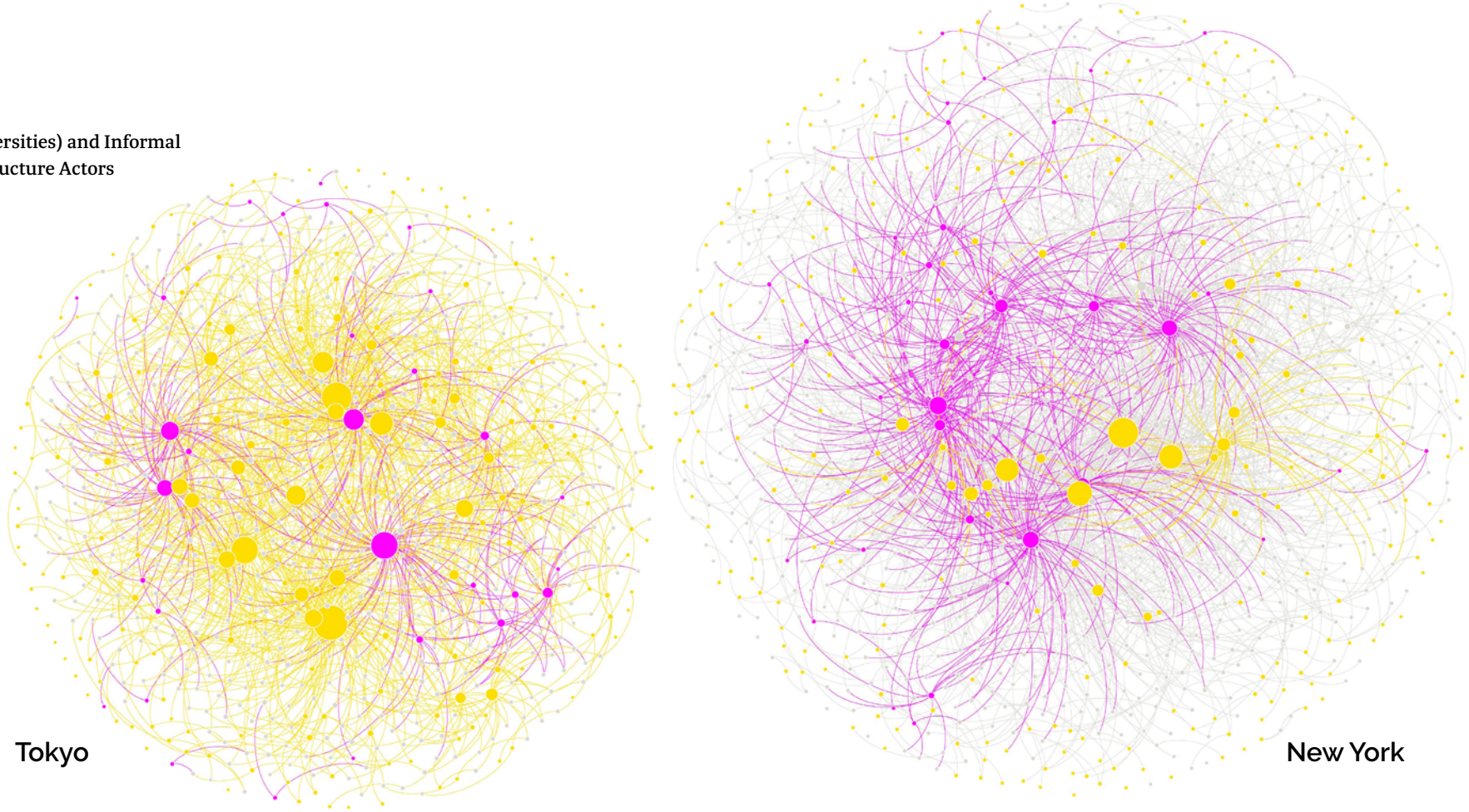
5.3 Entrepreneurship education in universities is expanding but it is concentrated in largest universities

5.4 Universities have strong R&D commercialization programs that results in deep-tech start-ups

5.1 Skills infrastructure ecosystem is dominated by institutions with limited start-up skills development

The entities that provide skills development support and infrastructure in Tokyo's ecosystem are primarily universities and corporate accelerators. The most influential entities are the top three universities in Tokyo (the University of Tokyo, Keio University, and Waseda University), followed by Kyoto University and two corporate accelerators in Tokyo. All other skills-supporting entities have a smaller influence, with the majority of accelerator programs being led by corporations (see figure 5.1). Organizations providing new models of entrepreneurial and technical skills (such as coding boot camps, growth-oriented accelerators and other training programs for rapid experiential skills) have a relatively small presence, with the niche AI.Accelerator being the most influential one, followed by Tech Planter, which focuses on R&D commercialization, and Open Network Lab.

Figure 5.1:
Ecosystem of Formal (Universities) and Informal (Specialized) Skills Infrastructure Actors



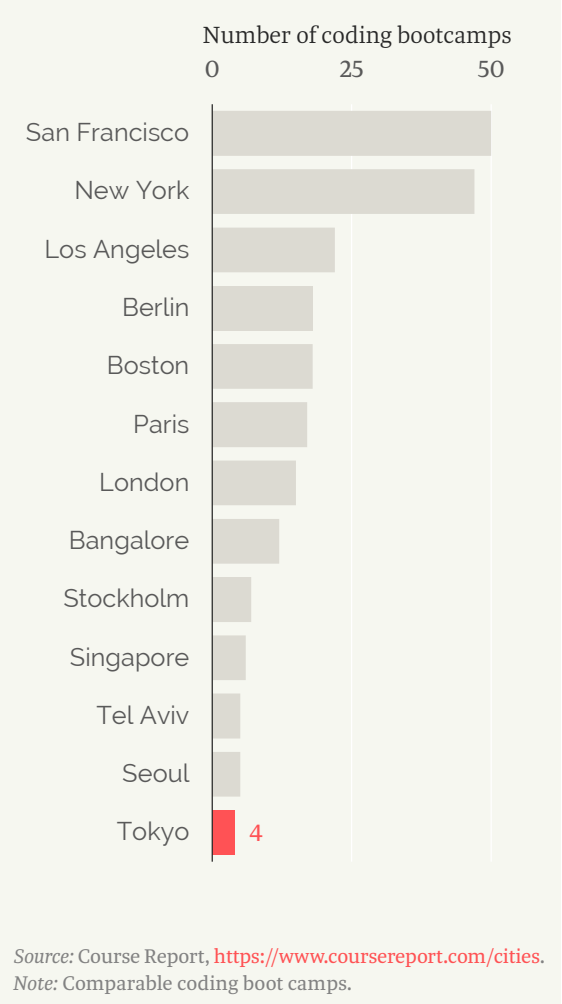
Source: Authors' analysis based on survey data, enriched with complementary sources (see Appendix A: Methodology).
Note: Dots represent ecosystem stakeholders. Lines represent connections between stakeholders and start-ups based on attendance to skills programs.

The limited presence of specialized organizations that enhance skills needed to start and run new enterprises contrasts with that of the leading start-up ecosystems, such as New York. In New York, skills infrastructure is highly diversified with complementary rapid skills training programs (accelerators and coding boot camps) supporting the ecosystem alongside a well-diversified set of domestic and international universities. Highly competitive accelerators, such as Techstars, Entrepreneurs Roundtable Accelerator, Betaworks, and 500 Startups create strong practical skills for founders as byproducts of their programs. General Assembly, one of the largest boot camps in New York, is influential in the ecosystem with a high degree of centrality as well, as it serves an important convening and community role in the ecosystem. Compared with other global start-up hubs, Tokyo has a limited number of coding boot camps (see figure 5.2). The lack of a wider presence of these additional skills providers limits the ecosystem's ability to upgrade and tailor formal education for local talent through experiential learning—a critical need for start-up founders and employees to gain business, technology, and entrepreneurial skills.

Additionally, the existing long-term employment structure in large corporations in Japan makes it difficult for experienced talent with business experience and developed networks in these companies to leave their positions to start a new venture. This structural limitation excludes the ecosystem from a critical population of potential successful founders. Mid-career experienced talent comprises the largest population of successful entrepreneurs (Azoulay et al. 2020). METI has recently introduced a new subsidy program aimed at addressing this issue and allowing this mobility to happen.[15] However, this program is still limited in scale and impact.

15 See new business creation support project cost subsidy, https://www.meti.go.jp/press/2021/07/20210709001/20210709001.html.

Figure 5.2:
Coding Boot Camps across Global Ecosystems



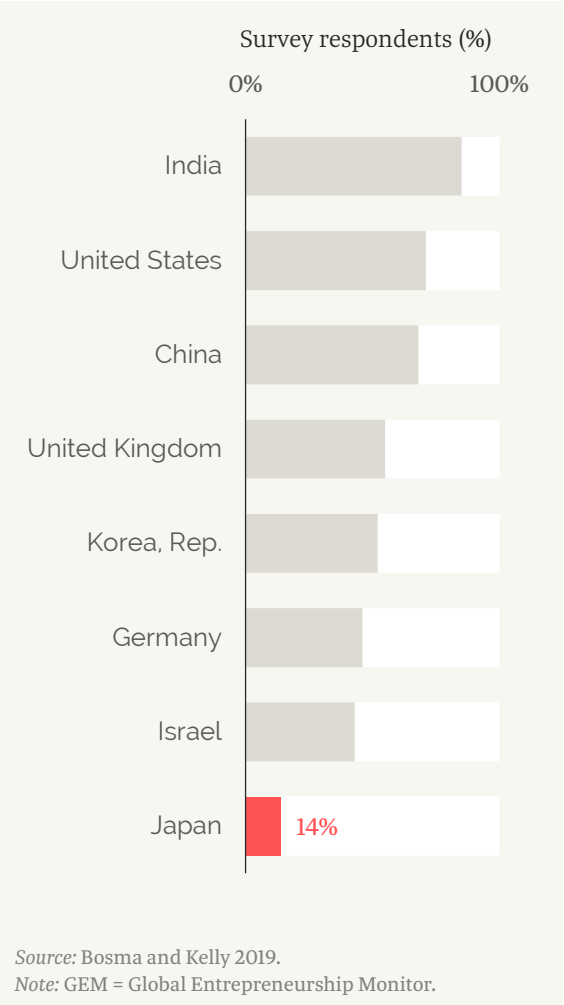
Source: Course Report, https://www.coursereport.com/cities.
Note: Comparable coding boot camps.

These limitations are particularly relevant for the Tokyo start-up ecosystem, which competes with established businesses for the limited technology and entrepreneurial talent in Japan. Interviews conducted for this analysis with Japanese start-up founders indicate that recruiting technical talent is one of the biggest challenges they face.[16] Technical and computing skills, together with soft skills, are scarce for the demand of the Japanese market. According to an IBM survey of business leaders in Japan, there is a gap between the expected needs of Japanese businesses and what the market can offer. About 70 percent of employers seek technical and computing skills, and more than 50 percent seek soft skills and entrepreneurial competencies (Ikeda, Marshall, and Zaharchuk 2019).

Support for developing and nurturing entrepreneurial skills is also critical. In Japan, entrepreneurial skills are perceived to be limited. The Global Entrepreneurship Monitor (GEM) reports Japan has just over 1 in 10 people with the knowledge, skills, and experience to start a business (see figure 5.3), the lowest of any country covered in the study (Bosma and Kelly 2019).

16 See Appendix A: Methodology for the list of interviews.

Figure 5.3:
GEM Survey — Adults with the Knowledge, Skill, and Experience for Starting Businesses (%)



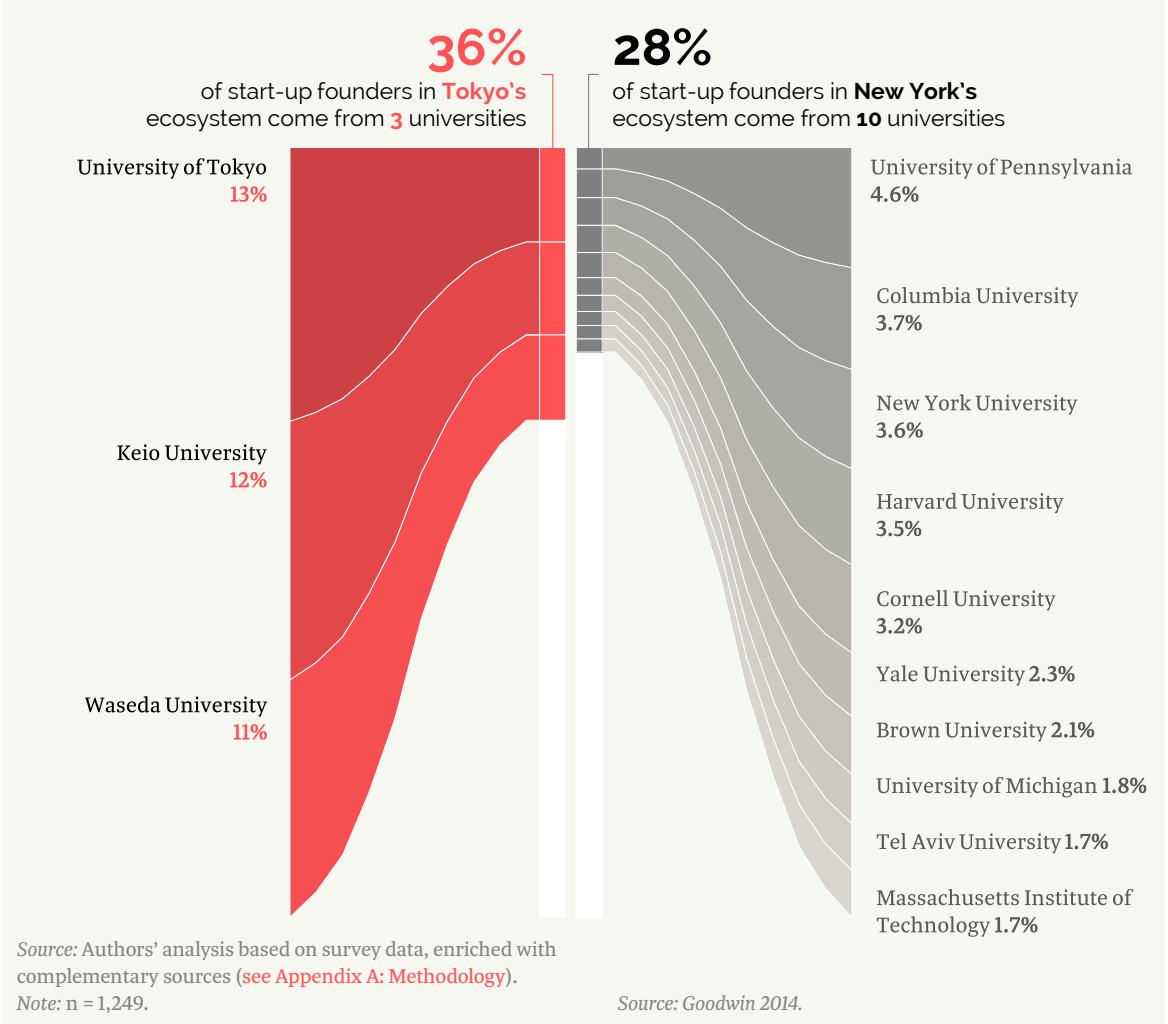
Source: Bosma and Kelly 2019.
Note: GEM = Global Entrepreneurship Monitor.

5.2 The ecosystem's formal skills infrastructure is highly local and concentrated in Tokyo, with little attraction of international talent

Tokyo's top three universities contribute the lion's share of talent to the local ecosystem, making them some of the most influential actors in the whole ecosystem, alongside the major financial institutions and investors (see section 2, Tokyo Start-up Ecosystem). These three universities account for more than 30 percent of all founders from the survey data of this analysis. Of the top 10 universities with alumni that have become founders, 9 are in Tokyo. The only university outside Tokyo that appears to be supporting the ecosystem is Kyoto University, which has fewer activities than peer universities from Tokyo (figure 5.4). There are very few graduates from master degree programs at universities abroad and very few foreign founders in Tokyo.

In contrast to this, almost 90 percent of founders in the New York ecosystem graduated from a university outside the city, indicating the city's gravitational pull on top talent (Goodwin 2014). The most influential universities are a varied group, comprising some of the top universities in the United States, including Harvard University, University of Pennsylvania, Stanford University, and Massachusetts Institute of Technology. No single university dominates New York's ecosystem. The largest share of university graduates of a single entity is below 5 percent with the top 5 universities having a similar share. There are also multiple foreign universities, with Tel Aviv University leading foreign institutions in graduates who go on to found start-ups in New York (see figure 5.5).

Figure 5.4:
Start-up Founders in Tokyo's Ecosystem, by University



Source: Authors' analysis based on survey data, enriched with complementary sources (see Appendix A: Methodology).
Note: n = 1,249.

Figure 5.5:
Start-up Founders in New York's Ecosystem, by University

Source: Goodwin 2014.

Other leading ecosystems rely heavily on foreign professionals to enhance the pool of entrepreneurial and software engineering talent. For example, more than half of the skilled technical labor force in Berlin, London, and Singapore are foreigners, with other ecosystems such as Beijing, Boston, San Francisco Bay area, and Shanghai also featuring high numbers of foreign tech talent (Tech Nation 2021).

Despite recent foreign visa measures adopted for start-up founders[17], skilled workers and landing support programs from cities (Shibuya Start-up Support program)[18], the Tokyo ecosystem has yet successfully attracted foreign founders and tech-skilled talent in significant numbers. Japan ranks lower than other global countries in the World Bank's Ease of Doing Business report and in the Organisation for Economic Co-operation and Development's (OECD) Talent Attractiveness index.[19] Interviews with ecosystem actors conducted for this report highlighted that business regulations are not friendly for attracting start-up founders. For instance, current regulation requires the *inkan* or *hanko* (personal seal) to open a bank account and a personal guarantor who must live in Japan to rent an office, which creates challenges for non-Japanese founders. The language barrier and a relatively conservative corporate culture were also highlighted as difficulties faced when establishing a business in Japan.

17 See https://www.meti.go.jp/english/policy/economy/startup_nbp/startup_visa.html

18 See Shibuya Startup Support, https://shibuya-startup-support.jp

19 See World Bank's Doing Business 2020, https://www.doingbusiness.org/en/rankings; OECD Indicators of Talent Attractiveness, https://www.oecd.org/migration/talent-attractiveness/.

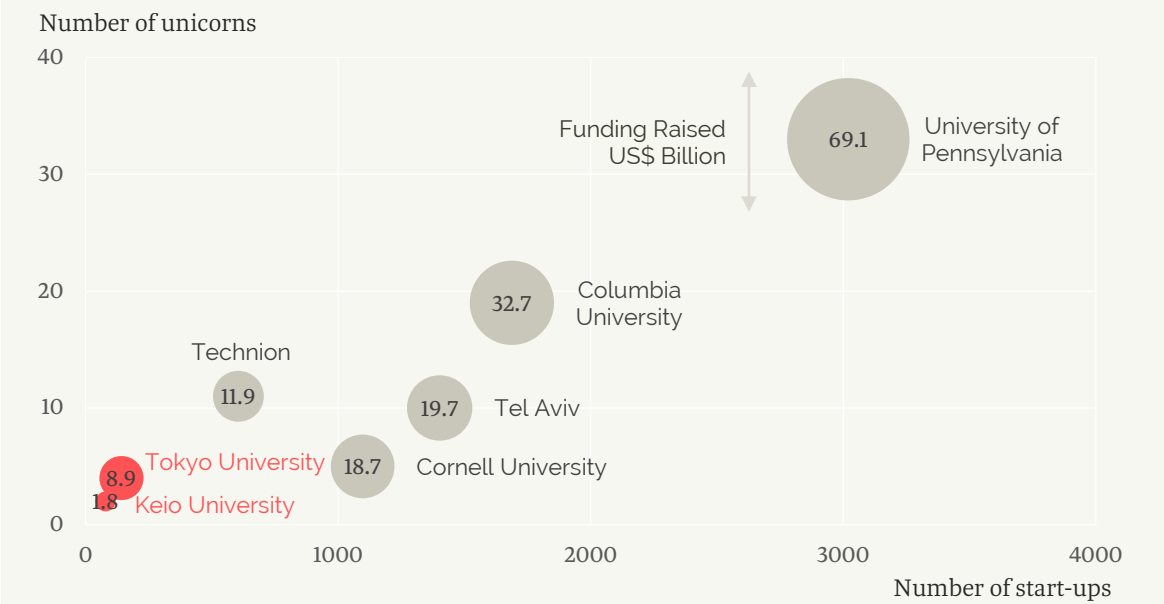
5.3 Entrepreneurship education in universities is expanding but it is concentrated in largest universities

Entrepreneurship education has been increasing in Japanese universities since the University Startup 1,000 Plan was introduced in the early 2000s. However, it has remained primarily theoretical with little experiential learning associated with it. With the expansion of the Enhancing Development of Global Entrepreneur (EDGE) program, university entrepreneurial ecosystems have started to emerge, although in most instances they are reserved for academia and PhD students to commercialize their research and outside investment for their venture capital (VC) arm (Shinato, Kamei, and Leo-Paul 2013). However, this academic and outside investment use has not yet produced sufficient outputs. The number of start-ups, unicorns, and funds raised by the alumni of Tokyo-based universities is still relatively small as compared with other leading large ecosystems, such as New York's, or niche innovation ones, such as Tel Aviv's (see table 5.1). In recent years, the three leading universities in Tokyo have been expanding practical entrepreneurial education together with a nascent practical entrepreneurial ecosystem for their student population. Although still more limited in numbers and scope compared with universities in other leading start-up ecosystems, this presents an expansion of critical practical entrepreneurial education in Tokyo's ecosystem.

While this combination of curricular and practical entrepreneurship education is advancing in Japanese universities, it is found in only a select few schools and has just recently been introduced. Additionally, there are few examples of university wide entrepreneurship strategies, suggesting that entrepreneurship education is seen as an auxiliary course or just applicable for commercialization of R&D. Compared with more mature ecosystems such as New York, which has a wider spectrum of entrepreneurship education offerings along with long-term commitments to R&D commercialization, Tokyo is only beginning to explore entrepreneurship education programs.

The majority of entrepreneurship education programs in Japan are contained in three universities, and the bulk of these programs were created only in the past decade. Although there are some robust programs, such as FoundX, an accelerator that offers experiential learning for building entrepreneurial skills that will be useful for starting and running companies, they are relatively new. The most common programs appear to be academic, teaching theory and frameworks that underpin the start-up journey rather than a program that offers students hands-on entrepreneurship experience.

Table 5.1:
Number of Start-ups Founded by Alumni Recorded in International Comparison Databases



Sources: Tracxn database (https://tracxn.com/) for US universities (June and July 2021); Crunchbase database (https://www.crunchbase.com/) for Japanese universities (May 2021).
Note: University of Pennsylvania and Columbia University combine data from undergraduate programs and their business schools.

5.4 Universities have strong R&D commercialization programs that results in deep-tech start-ups

Key *takeaways*

1. Tokyo's universities are expanding their entrepreneurship education programs, but those are still limited and lacking practical entrepreneurship programs beyond the main three universities. The national university system has yet to play the necessary role in producing talent for the ecosystem. Whereas Japan and Tokyo boast a long track record in producing high-end science and technology talent in its universities—and there are indeed some notable examples of entrepreneurship programs and funds in universities—nationally the education system has yet to create specific talent for start-ups at the same rate as other major economies and metropolitan areas.

2. University R&D commercialization presents an opportunity for larger deep-tech specialization, connecting to Japan's highly developed innovation system. Japanese universities are becoming increasingly involved in commercializing technologies. From an ecosystem perspective, such efforts are a boost for tech start-ups, particularly deep tech, which tend to be rooted in rigorous research. This uptick in commercialization could also, in general, help more universities integrate into the ecosystem. Leading universities in Japan are becoming increasingly involved in the start-up ecosystem.

3. There are still a very limited number of informal entrepreneurship programs that can expand the talent base for the ecosystem beyond university students. Beyond universities, start-up ecosystems require specialized skills-development organizations to grow. Accelerators and coding boot camps, for instance, play an instrumental educational role in the ecosystem by providing training, mentorship and network access and by expanding the critical mass of founders population by providing experiential and informal venues for a larger diverse set of population beyond university students, such as mid-career employees and the unemployed. Whereas Tokyo is not devoid of such organizations, the city has few designated institutions for building entrepreneurial skill sets compared with other major ecosystems around the world.

Japanese universities have developed strong R&D commercialization programs, which include mentorship and talent matching for founders, as well as connections to accelerators and VC funds. Initially catalyzed by government programs, these policies have resulted in a growing number of university start-ups. These commercialization efforts have continued to be supported by research ideation and commercialization programs from the Japan Science and Technology Agency (JST).[20] The agency has recently introduced start-up commercialization programs to support its basic research programs, which amount to ¥40 billion (around US$400 million) annually on average (JST 2020). This has also resulted in some conversion of research in start-up companies, although still very limited in numbers.[21]

A METI report announced that there were more than 2,566 university-affiliated start-ups in Japan by 2018, and the number has been growing since 2014 (METI 2020). Funding raised by university-launched start-ups represented approximately 10 percent of start-up financing according to data reported in 2020 (INITIAL 2021).

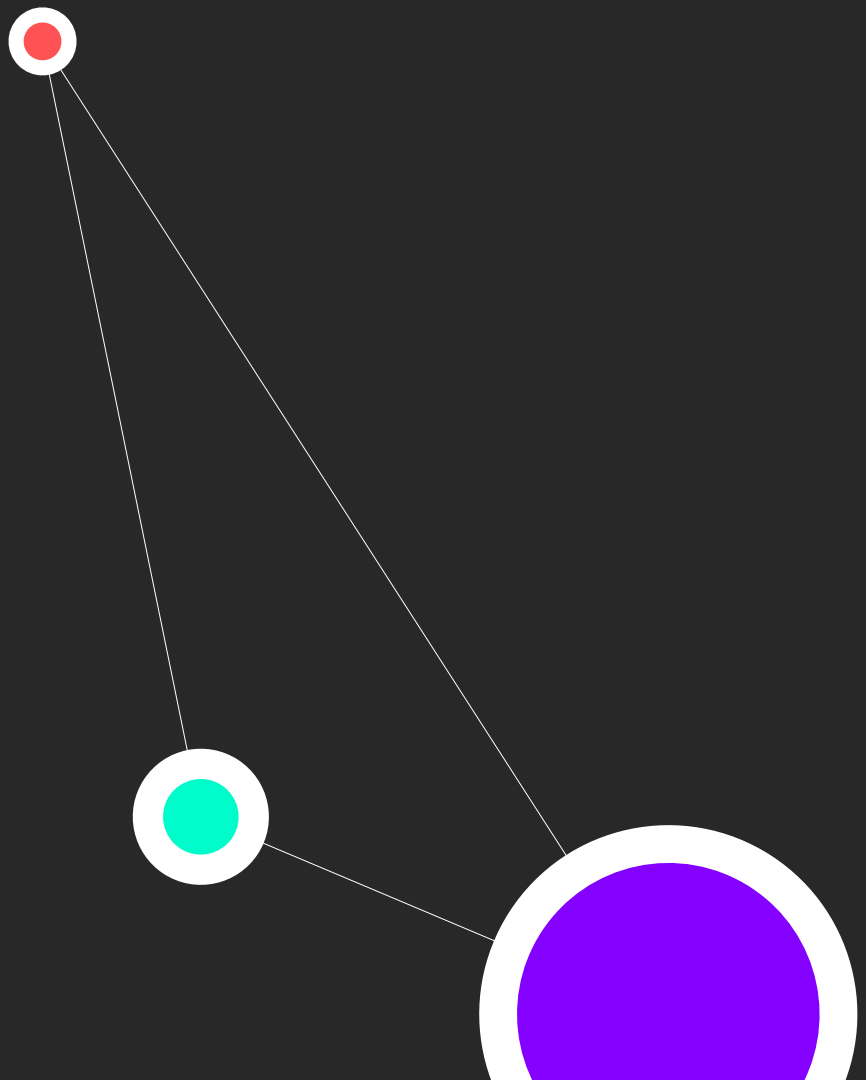
Similar to the distribution of start-up founders, the University of Tokyo contributes the biggest share of university-affiliated start-ups (Naron 2018). According to Teikoku Databank in April 2017, 10 percent of university-affiliated start-ups originated from the University of Tokyo, and more than 40 percent of the listed university start-ups are associated with the University of Tokyo.[22] Kyoto University produces half as many start-ups as does the University of Tokyo, followed by the University of Tsukuba, Osaka University, and Tohoku University.

Most of these start-ups operate in deep-tech sectors and are connected to commercialization of R&D from these leading science and technology universities. These results show the potential of the traditional innovation ecosystem when combined with the start-up ecosystem (see Introduction: Start-up Ecosystems Are Critical Assets for Innovation-Driven Competitiveness). Further integrating universities with the larger ecosystem will be critical for the growth and competitiveness of Tokyo's overall start-up ecosystem.

20 These efforts include research catalyzation such as Moonshot Research and Development; ERATO (Exploratory Research for Advanced Technology); ACT-X, which supports young researchers in pursuing ground-breaking research projects; and specific commercialization programs, such as START (Program for Creating Start-ups from Advanced Research and Technology) and SUCCESS (SUpport Program of Capital Contribution to Early-Stage Companies). For further information, see Japan Science and Technology Agency programs, https://www.jst.go.jp/EN/programs/funding.html.

21 For instance, of the ERATO program, two start-ups resulted from the five researchers that were funded in the program in 2017 and 2018. Although a high percentage, the absolute number is still limited to have a systemic effect in the ecosystem. See JST (2020).

22 See Beyond Next Ventures, Summary of Listed Ventures from Universities, https://beyondnextventures.com/about/.



Section 6

Key Strengths and Opportunities

This section highlights the key strengths and good practices developed in Tokyo's ecosystem as well as key opportunities for further growth. Tokyo's case is also a good example for countries that have invested in deep tech and advanced sciences. Moreover, its deep integration in the larger, urban development efforts presents a complementary approach to those of other urban ecosystems that have leveraged start-ups for urban vitalization and city competitiveness. With high levels of public sector engagement and leadership to grow the ecosystem at the urban, regional, and national levels, Tokyo's ecosystem can evolve into a highly specialized global innovation hub, combining its national strengths in science, technology, and innovation fields with the start-up ecosystem.

6.1 Key Strengths of Tokyo Ecosystem

The following are Tokyo start-up ecosystem's key strengths:

Strong focus on commercialization of university R&D and active presence of universities in the ecosystem

Following the introduction of key government programs (for example, university venture capital [VC] funding programs, the Enhancing Development of Global Entrepreneur [EDGE] program, Japan Science and Technology Agency [JST] commercialization programs, and so forth), Japanese universities have steadily created more start-ups that are linked to R&D and science, technology, and innovation (see section 5, Skills Infrastructure). The University of Tokyo accounts for more than 40 percent of start-ups created by Japanese universities to date. This strong focus on commercialization of R&D from top research universities stems from an intentional strategy to address key gaps in R&D commercialization in Japan. Each university has developed its own programs, which include a mixture of practical entrepreneurship education, competitions, and challenges, on-campus incubators and accelerators, mentors, business CEOs paired with academics to launch new ventures, and associated venture capital funds. Together with other measures to facilitate translational R&D, these efforts have resulted in a higher rate of commercialization of R&D through start-ups and, in particular, the production of deep-tech ventures.

Entrepreneurship education and practical entrepreneurship programs have become more prevalent in university campuses, as universities have incorporated more than just the initial EDGE program (extended as EDGE NEXT across universities). See Waseda University (2017). Although there is still room for further development of the larger university-start-up ecosystems (see Key Opportunities in this section), these programs helped to lay the foundation of these ecosystems, which yielded unique accelerators such as Leave a Nest and Tech Planter and R&D commercialization opportunities. Furthermore, with the creation of VC funds, universities not only invested in new R&D-backed companies, but also in start-ups that weren't linked to them. University-affiliated VCs, particularly the VC University of Tokyo Edge Capital (UTEC), are preeminent investors in the ecosystem with high centrality.

Tokyo's leading universities play a critical role in supporting and expanding the Tokyo ecosystem. Ecosystem stakeholders are highly connected with the leading Tokyo universities (see section 5, Skills Infrastructure), with more than 60 percent start-up founders for this analysis and half of unicorns founders in the country coming from the three most influential universities in Tokyo (University of Tokyo, Keio University, and Waseda University).

Strong focus on corporate innovation and R&D commercialization with presence of leading global corporations

Similar to universities, Japanese corporations have a strong presence in the start-up ecosystem with open innovation, sourcing of new innovations and technologies, and R&D commercialization. They help connect the ecosystem with the country's wider efforts in science, technology, and the general innovation verticals, as well as corporate R&D activity with the start-up ecosystem. By virtue of playing this role, Japanese corporations also can expand their internal innovation processes into the start-up ecosystem itself, which is needed for competing in deep-tech verticals globally (for example, AI, robotics, battery storage, and others).

Tokyo's ecosystem has one of the largest presences of corporate investment among global ecosystems, with more than 60 percent of start-up rounds having a corporate investor such as a corporation or corporate venture capital (CVC). This number is nearly three times larger than that of Boston, New York, and San Francisco (see section 3, Investment). This noticeable involvement of Japanese corporations in the ecosystem has resulted in the development of corporate accelerators, CVCs, and separate investment vehicles that support the creation of new ventures aligned with tangible market opportunities. Furthermore, this involvement has given rise to developing innovative products and services for strengthening Japanese corporations' offerings and acquiring new technologies, for example, through CVC investment in foreign

markets. In many other ecosystems, corporations may be late movers that do not as easily or frequently invest in and partner with start-ups; but in Tokyo that is not the case, thereby positioning the city near the front of the pack.

The strong demand of Japanese corporations to source and access innovations from the start-up ecosystem has led to developing a new corporate innovation sector. There are now multiple providers of start-up innovation and corporate acceleration, as well as specialized actors such as Plug and Play — the only global accelerator program with a permanent presence in Japan (see section 5, Skills Infrastructure). The combination of this strong presence and focus on tangible market-oriented innovation with the high-quality demand required by Japanese corporations has strengthened the deep-tech focus in the ecosystem. In addition, Tokyo's ecosystem is home to one of the largest corporate investors globally, SoftBank Group Corp., which plays a notable role in the global VC community and helps to connect the Tokyo ecosystem with other global deep-tech hubs.

However, the corporate sector has not yet produced a significant number of start-up ventures, thus there is room for improvement. In particular, the sector can increase the prevalence of corporate open innovation and absorption mechanisms, wherein corporations engage start-ups as part of their innovation process (see Key Opportunities in this section) that in turn can help integrate breakthrough technologies from the wider Japanese R&D system into global markets. As global corporations look to further embed start-ups in their work (see section 3, Investment), Tokyo's and the larger Japanese ecosystem can provide a model.

Highly competitive deep tech with quality innovation and start-up outputs

The large presence and involvement of universities and corporations from Japan's science, technology, and innovation system has resulted in a strong niche of deep-tech start-ups in Tokyo's ecosystem. About half of the unicorns generated in Tokyo leverage deep-tech technologies. Tokyo start-ups are highly competitive in advanced technology domains, including AI, robotics, Internet of Things, bioengineering, space technologies, lithium-ion storage batteries, advanced materials blockchain, and clean technology, among others. Although the bulk of start-ups of the ecosystem are related to software, e-commerce and fintech, deep-tech start-ups are growing in number, with AI being the most VC-backed sector in 2020 (see section 2, Tokyo Start-up Ecosystem).

Activity surrounding deep-tech start-ups is bringing together Japan's leading science, technology, and innovation systems with the start-up ecosystem. R&D-driven start-ups from universities are emerging from top scientific institutions in the top science, technology, and innovation hubs that do not have preeminent start-up ecosystems. Those include the following:

- Universities in Kyoto-Osaka-Kobe area (Kyoto University and Osaka University), Fukuoka (Kyushu University), Nagoya (Nagoya University), and Sendai (Tohoku University)
- Large corporations including Toyota, Honda, Panasonic, Denso, Sony, and Takeda Pharmaceuticals
- Science and technology institutions, such as the Japan Aerospace Exploration Agency and the National Institute of Advanced Industrial Science and Technology[23]

By further expanding the potential of the ecosystem to connect specialized science, technology, and innovation hubs in the country, these institutions can contribute to the growth of a global start-up ecosystem hub in these areas (see Introduction: Start-up Ecosystems Are Critical Assets for Innovation-Driven Competitiveness).

Although still in its early stages, this concentration on deep-tech companies, experts, and resources produces competitive ventures globally. Further expansion of start-up ecosystem infrastructure in Tokyo and the development of niche start-up hubs across the country's innovation centers could result in a growing pipeline of high-quality deep-tech ventures that create new markets and technologies in Japan's corporate sector (see Key Opportunities in this section).

Potential strong government support for programs nationwide

Tokyo's ecosystem has benefited from active government programs that have integrated key science, technology, and innovation actors with the start-up ecosystem. As mentioned previously, government

23 Japan Aerospace Exploration Agency (JAXA), https://global.jaxa.jp/; National Institute of Advanced Industrial Science and Technology (AIST), https://www.aist.go.jp/aist_e/about_aist/index.html.

leadership and involvement in start-up communities is prevalent in leading ecosystems around the world. In Japan, government efforts to support the ecosystem have included the creation of university entrepreneurship education programs, VCs, and R&D-start-up commercialization programs (see section 5, Skills Infrastructure), as well as the creation of the public-private partnership INCJ (Innovation Network Corporation of Japan) or the tax incentives for establishing CVCs (see section 3, Investment). Regional and city governments have developed and implemented support policy programs, with the Tokyo Metropolitan Government providing grants, mentorship, and training facilities to potential entrepreneurs, among other support programs. Similarly, city governments are actively supporting start-ups to attract domestic and international talent and ventures to the area, such as the Shibuya Startup Support program.[24] Both regions and cities have active accelerator programs that are in or connected to the Tokyo ecosystem, such as the Aoyama Startup Acceleration Center and start-up hubs such as Osaka Innovation Hub.[25] METI and NEDO (New Energy and Industrial Technology Development) have multiple grant programs that support entrepreneurs at the early stages (see section 4, Support Infrastructure) and that also introduce new programs to talent from large corporations to become entrepreneurs.

The active participation and support of policy actors is a potential strength for the ecosystem, which benefits from myriad programs. Further integration and coordination of these policy programs can help scale the Tokyo start-up ecosystem, helping to grow niche networks and innovation hubs. To that end, the Cabinet Office recently launched that start-up city initiative (Cabinet Office 2020), which selected four hubs as global start-up base cities (Greater Tokyo area, Osaka-Kyoto-Kobe, Nagoya, and Fukuoka) and four cities as start-up promotion base cities (Sapporo, Sendai, Hiroshima, and Kitakyushu) with the goal of promoting these ecosystems. Additionally, this effort seeks to better coordinate regional and local strategies with a national approach, while allowing independent hubs to develop strategies focused on their core assets and competencies (see Key Opportunities in this section).

24 See Shibuya Startup Support, https://shibuya-startup-support.jp/.

25 See Ayoama Startup Acceleration Center, https://acceleration.tokyo.jp/; Osaka Innovation Hub, https://www.innovation-osaka.jp/.

6.2 Key Gaps of the Ecosystem

Despite these strengths, Tokyo's ecosystem presents a series of gaps relative to its potential as a leading global start-up ecosystem. The summary of the main identified gaps of the ecosystem is in table 6.1.

Table 6.1:
Tokyo Ecosystem's Gaps

Ecosystem Area	Key Gap
Investment	• Limited growth-oriented specialized funding (for example, VC fund and angels) and experienced talent • Funding ecosystem dominated by domestic nongrowth specialized entities limiting entry of international competitive actors • Limited funding beyond early stage and dominated by a limited domestic market growth focus
Support infrastructure	• Very limited presence of specialized start-up-oriented support programs, with no permanent presence of global programs • Specialized start-up-oriented programs that have domestic focus and are small, with limited access to mentors and knowledge for larger growth • Nascent community of angel investors and mentors with successful start-up experience, with limited exposure to nondomestic growth and international networks or mentors and funding
Skills infrastructure	• Nascent practical entrepreneurship education limited to the largest universities; lack of large developed university start-up ecosystems • Limited presence of informal practical entrepreneurship skills entities (for example, boot camps and accelerators) to expand talent beyond university population • Highly domestic focus of skills programs with little exposure to global markets and resources
Overall	• A small, limited growth-oriented start-up ecosystem with potential to produce start-ups to grow and compete at global scale • Limited access to practical knowledge, know-how, talent, and funding to grow internationally with little available resources for an international mindset • Limited capacity to cope with internal demand of start-up innovation, with large gap in trade-funding balance investing abroad from corporate sector

Ecosystem gaps can be addressed with policy actions that tackle existing market failures or catalyze organic growth through private sector actors and attracts start-up-oriented ecosystems stakeholders. Table 6.2 shows examples of policies developed by other leading ecosystems to address similar gaps.

Table 6.2:
Tokyo Ecosystem's Action Areas

Ecosystem Area	Action areas
Investment	• Attract and catalyze specialized investment funds (such as independent VCs) for start-ups with a growth orientation, particularly in mid and later stages. • Attract seasoned investment talent that is growth oriented with global experience in global start-up (independent VCs) fund management that is also growth oriented. • Provide tax incentives for corporations and universities to develop growth-oriented investment and attract globally experienced talent for VC and corporate-led support programs. • Establish or foster the development of international investment standards for VC and start-up investment, similar to European investment guideline or the US Security Exchange Commission standard rules.
Support infrastructure	• Attract global specialized-start-up support programs (for example, accelerators, start-up hubs, competitions) to develop programs in the ecosystem and connect domestic founders with global talent (colocation and team-matching of domestic and international founders). • Foster the development of globally competitive vertical and deep-tech accelerator programs with leading corporations and universities with an international growth orientation. • Attract experienced global-oriented start-up talent and connect its ecosystem through structured global programs such as UK Global Entrepreneurship Program or K-Startup. • Provide tax incentives for angel investment for individual successful business founders in domestic start-ups.
Skills infrastructure	• Expand incentives and programs to support universities to build practical entrepreneurial education ecosystems, including challenges, acceleration, early-stage funding, and increase the international-growth mindset. • Attract international leading programs and catalyze transformative innovation and deep-tech university programs to introduce start-up education that is based on practical projects, such as at the New York Roosevelt Island Campus. • Expand university R&D commercialization programs across innovation hubs and connect them with growth-oriented globally competitive support programs and specialized start-up investment. • Provide incentives to foster informal practical entrepreneurship and technology trainings programs such as boot camps and accelerators for non-university populations, and connect them to corporations.

6.3 Key Opportunities of Tokyo Ecosystem

On the basis of the identified strengths and gaps, the following are the Tokyo start-up ecosystem's key opportunities to expand into a global start-up ecosystem hub.

Enhance the support infrastructure, launch more specialized funds and skills infrastructure actors

Expanding and increasing the diversity of specialized support and skills infrastructure programs and investors would allow the Tokyo ecosystem to produce a larger number of ventures and to support their growth at larger stages that can compete at global level.

Current support infrastructure actors are primarily corporate accelerators. Increasing the number and quality of specialized accelerators would help to create larger more competitive ventures. Creating and attracting acceleration programs that can bring an adequate mix of top-notch investment, training, mentorship, and partnership access and also have a permanent presence in Tokyo is essential. Government initiatives at the national, regional, and city levels have attracted ad hoc international acceleration programs such as TechStars[26] and the 500 Startup Kobe Accelerator program.[27] However, as these programs had no permanent base, it is unclear if they had a substantial effect within the ecosystem. In addition to accelerator programs, fostering and attracting global events that enable access to global resources for start-ups and that increase the links between ecosystems in different countries are important to position Tokyo as a global start-up hub. Together with global events, globally focused accelerators can help to attract talent and resources from other leading start-up ecosystems.

To support the growing number of globally competitive start-ups in Tokyo's ecosystem, it will need to expand the size and volume of specialized VC investors and diversify funding sources to increase funding and support to medium- and later-stage companies. Most VC funds in Japan focus on early-stage start-ups, meaning that there are few investor options for mid- to late-stage companies (see section 3, Investment). Enticing more international VC funds would also increase the access to funding and expertise for Tokyo ventures, in turn helping them to expand globally. Subsequently, as the start-ups grow into global entities, the talent and capital that they attract can help to strengthen the Tokyo ecosystem as well — potentially leading to more and larger funds as well and thus leading to more funding options for late-stage firms. Except for the United States and China, it is very common for globally competitive ecosystems to feature notable amounts of international VC funding for their unicorn companies, and for high potential start-ups in general (see section 1, Overview of Japan's Innovation Ecosystem, and section 3, Investment).

To complement the expansion of entrepreneurship education in formal educational institutions, and to increase the pipeline of affordable, employable talent for start-ups, the ecosystem would benefit from a wider offering of experiential training in technology and entrepreneurial skills verticals. Coding boot camps and other rapid experiential learning programs, such as business plan competitions, hackathons, and pitch events all provide these types of trainings and skills. Policies to attract and foster these programs at a large scale would support the cultivation of these skills and consequently expand the talent pipeline of founders and employees.

Expand universities' and corporations' start-up ecosystems and integrate them into the larger Tokyo start-up ecosystem

There is great potential to increase the deep-tech innovation and start-ups from Tokyo's universities (see Key Strengths in this section). The city's universities have introduced entrepreneurship programs with practical and experiential activities that are paired with start-up support programs, such as incubators and accelerators (see section 5, Skills Infrastructure). However, these are still nascent, producing a limited number of start-ups and are not evenly developed across universities in the ecosystem.

Large-scale university programs that are available to all students and alumni and integrated across disciplines — with experiential entrepreneurship activities, competitions, and acceleration paired with VC funds — would enhance university start-up ecosystems. Similar large-scale programs have been implemented at top global universities. However, these ecosystems cannot be created in a vacuum. As in the case of these leading universities, their ecosystems need to be integrated into the overall start-up ecosystem.

26 See ACN Newswire, Techstars Announces 'Startup City Acceleration Program' in Partnership with Japanese Government to Support the Global Expansion of 50 Japan-Based Startups." Asia Corporate News Network, January 27, 2021. https://www.acnnewswire.com/press-release/english/64188/techstars-announces-'startup-city-acceleration-program'-in-partnership-with-japanese-government-to-support-the-global-expansion-of-50-japan-based-star.

27 See: 500 Startups Kobe Accelerator, http://500kobe.com/.

Expediting the integration of corporations within the start-up ecosystem such as corporate accelerators, CVCs, and other investment facilities would increase the connectivity between Japan's corporate R&D efforts and the start-up ecosystem. Upgrading corporate-start-up programs and corporate investment strategies to ensure that they are producing scalable companies will also help the ecosystem compete globally in new technological areas. Introducing corporate innovation hubs, such as the Chicago Manufacturing Hub (mHUB)[28] for cocreation and testing of new technologies across corporations and start-ups, CVCs such as Google Ventures or Salesforce's venture arm (CBInsights 2019b; Levy 2021) could further expand corporate integration, resulting in a higher number of new ventures that are aligned with Japan's corporate market priorities.

Given the large level of corporate R&D investment activity among Japanese corporations, relative to VC investment in Tokyo's start-up ecosystem, (see section 2, Tokyo Start-up Ecosystem), greater integration of corporate R&D activity could greatly improve the Tokyo ecosystem's outputs.

Develop global and niche start-up ecosystems, and integrate innovation and start-up clusters at the national level

Equally, expanding the commercialization support of existing public research programs (for example, JST-supported programs) to gain scale and to further connect Japan's global science, technology, and innovation hubs with Tokyo while enlarging their start-up ecosystems will strengthen the already competitive deep-tech focus of the ecosystem; it will also expand the transformation of Japan's innovation system into a start-up-innovation model (see Introduction: Start-up Ecosystems Are Critical Assets for Innovation-Driven Competitiveness). Japan is home to global innovation hubs and has multiple cutting-edge science, technology, and innovation institutions, including internationally competitive corporations (see table 6.3). Global start-up ecosystems do not operate on their own; they are connected to niche and regional start-up hubs that feed each other. Global ecosystems provide the necessary resources and access to international markets needed for start-ups to grow and compete globally, whereas niche hubs will bring specialized knowledge, innovation, and talent.

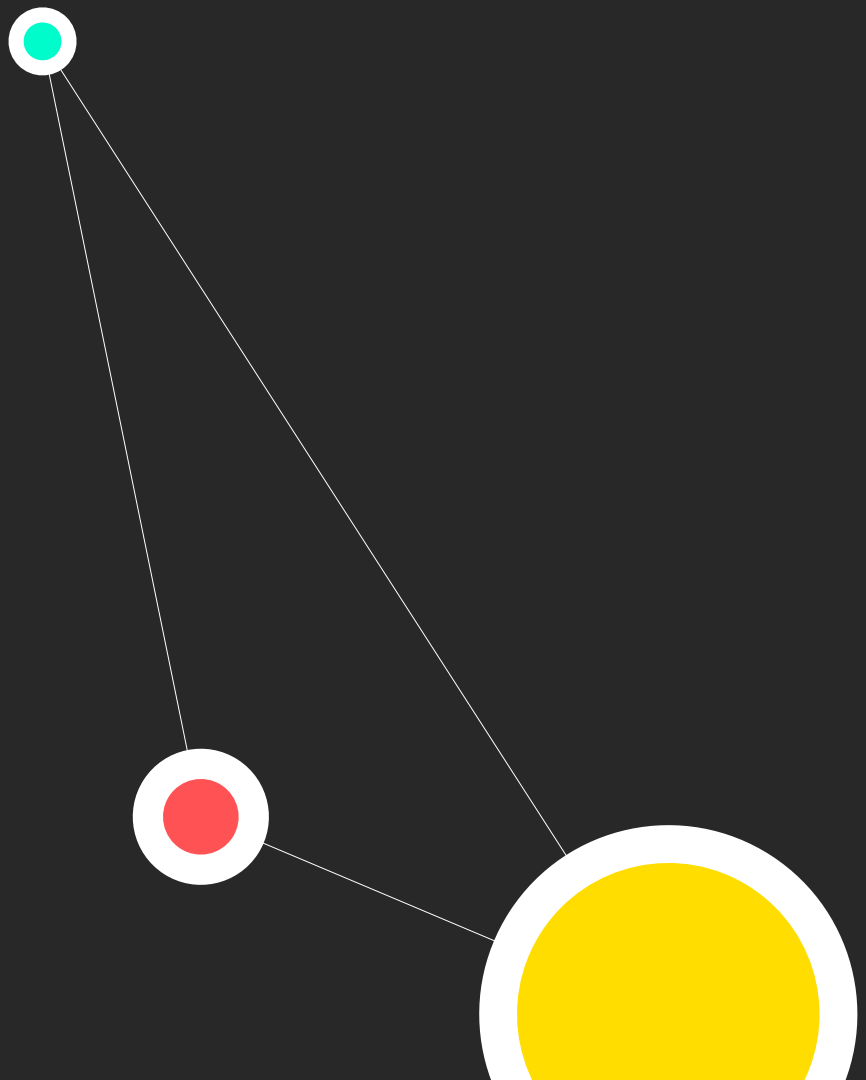
The recent "Beyond Limits. Unlock Our Potential. Strategy" from the Cabinet Office (2019) identified opportunities in several leading metro areas where activities in their start-up ecosystems could better align with policies at the city, regional, and national levels. The highest priority areas were the Greater Tokyo area, Kansai area (Osaka-Kobe-Kyoto), Fukuoka, and Nagoya, all of which have start-up policy programs and have developed nascent start-up ecosystems (see table 6.3) (Cabinet Office 2020). Expanding these ecosystems and their connectivity among each other will reinforce Japan's start-up ecosystem as a whole and align its cutting-edge innovation and knowledge resources with a larger start-up-innovation ecosystem that is fully integrated with global start-up activity.

28 See mHUB, https://mhubchicago.com/.

Table 6.3:
Examples of Selected Japan's Start-up Innovation Hubs

Region/City	Competitive niche	Relevant organizations
Kansai: Osaka/Kobe/Kyoto	Health tech Biotech	• Umekita Phase 2 Development Project • Japan Biodesign • Nakanoshima Future Medical Int'l Site Project • Remohab • Kobe Biomedical Innovation Cluster (KIBC) • Megakaryon (iPSC)
Kyushu: Kitakyushu/Fukuoka	Advanced robotics Drones Life sciences	• Foundation for the Advancement of Industry, Science and Technology (FAIS) • Kitakyushu Robot Forum • Manufacturing Innovation Center • Kitakyushu Science and Research Park • Kyushu Institute of Technology • Yaskawa Global • KAICO • ComQuest
Nagoya	Autonomous vehicle software, rechargeable batteries	• Nagoya University originated start-ups involved in autonomous vehicle SW/HW • Tier IV • Autoware Ltd • Global Research Institute for Mobility in Society
Sapporo/Muroran	Space tech	• Hokkaido University • Muroran Institute of Technology • Interstellar Technologies • Space-Agri • Polar Star Space • JAXA Ventures (focused on aerospace start-ups) • Open Network Labs Hokkaido • Sapporo Tech Accelerator and Resource for Startups

Sources: Author's work based on Cabinet Office, 2020.



Appendix A

Methodology

Measuring the Tech Start-up Ecosystem

Measuring the Tech Start-up Ecosystem

Measuring the tech start-up ecosystem is not a simple task. Relevant databases of start-ups are not readily available, and the fast-paced and multidimensional dynamics of this start-up ecosystem — with new ventures constantly being created, failing and being closed, or being bought or transformed (changing name or purpose, or both) — make accurate measurement over time inherently difficult.

Some databases include limited information on start-ups. Such databases include those that are global, local (mostly at the level of metropolitan areas), and, in some cases, domestic (countrywide). Both open and proprietary databases are in this category. Access to proprietary databases, such as PitchBook, CBInsights, Dealroom.co and TRacxn, is limited and in some cases restricted (not open to wider research). The most relevant open databases of start-ups are Crunchbase and AngelList. Neither of these databases, however, provides accurate or complete information. For instance, Crunchbase is a self-reported database that is not curated by an official entity; as such, it may include inaccurate information, such as closed or transformed ventures still being posted with the original data, founders omitted, and so on. Conversely, AngelList generally contains more accurate information because start-ups listed there have received or are actively soliciting investment from angel investors or venture capital (VC) firms. Both databases also have an overall representation of US ventures with data from other countries often misrepresented or incomplete. Other global start-up repositories, such as Startup Genome, build on these databases and additional self-reporting data and are therefore subject to similar limitations. Finally, although LinkedIn can provide more accurate data on start-ups through funders and employers, data access and use restrictions make it difficult to use for independent research.

Moreover, since Japanese start-ups are largely domestic-oriented and have limited information in English, the global databases usually have less coverage of the start-up data for Japan. Thus global databases are of limited use in helping to build an overall picture of the tech start-up ecosystem. For example, at the time this analysis was conducted, PitchBook has documented only about 2,000 Japanese start-ups.

Regional and local start-up databases can be richer in data and more accurate, since they are often the result of an active effort to track their activity and life cycle. Examples of these databases are Digital NYC in New York, Tech Nation in London, and INITIAL venture database (formerly known as Entrepedia) and Startup DB in Japan. However, these databases have localized methodologies, so their data are difficult to use for comparative analytics.

To address the data shortcomings for the Japan/Tokyo start-up ecosystem analysis, we used the INITIAL venture database as the foundation of our analysis. This data set was complemented by desktop research and surveys done by the World Bank team in partnership with Japanese research partners. For a broader description and technical details of the methodology followed and databases used, see the Data and Methodology section in this appendix. The main data set contains information of 3,305 start-ups (founded after 2005), which are in Tokyo, Kansai region (Kyoto, Nagoya, and Osaka), Kobe, and Fukuoka. This data set has general information about each company, such as founding year, address, type of business, founder's information such as education and previous jobs, and the associated investors and accelerators.

The survey and desktop research were combined with information from interviews with key stakeholders of the ecosystems from 121 organizations, including start-ups, VC firms, accelerators and incubators, collaborative spaces, universities, and government agencies. These interviews provided qualitative data such as the key challenges of the start-up ecosystem and also served to cross-validate the findings from quantitative analysis.

The data set is not exhaustive, and it represents only a subset of Japan's ecosystem start-ups. Moreover, it is subject to survivorship bias and does not include start-ups that have not survived to the date of data collection. However, it is still a relevant subset because this data set was complemented by other existing data sets and interviews. Given the lack of other data sets for the country and even though the data set has information from different sources, the data provide one of the richest samples collected to date of the most influential start-ups, founders, investors, and other ecosystem stakeholders in Japan.

Finally, this report assumes that because of the fast-moving nature of the start-up ecosystem, any attempt to accurately measure the tech start-up ecosystem is inherently flawed—any measurement will be obsolete immediately after collection, and some of the information presented in this report might vary significantly because of the ongoing pandemic and its (not-yet-quantified) effects on the ecosystem. The findings and lessons learned that are presented in this report should be interpreted with these limitations in mind. Less emphasis should be placed on exact numbers, which are subject to change with the addition of more start-ups and which are sensitive to minor tweaks in methodology. Rather, the data collected enable analysis of general trends and the dynamics of the ecosystem that can inform specific policies. This analysis should not be considered in isolation, and policy makers are encouraged to confirm these findings with other available sources (for example, perspectives from practitioners and anecdotal evidence).

DATA AND METHODOLOGY

The analysis presented in this report follows a mixed-method and "all-data" approach. This means that it combines deep literature review, stakeholder interviews with quantitative data analysis, and qualitative research. This all-data approach encompasses the use of sample surveys, proprietary data, open data, and web data. Integrating synergies among existing data sets is a salient feature in the proposed methodology for assessing and measuring entrepreneurship ecosystems. Existing entrepreneurship methodologies typically take advantage of only a single data source, such as traditional sample surveys, and are limited by the design artifacts of the data source.

This analysis uses a mix of desk research, web scraping, and survey instruments to gather data from administrative sources and online sources. For online sources, this may entail web scraping public sources with a focus on (a) social media, (b) company websites, (c) location data, (d) government open data sites (if available), applying OCR as well as code to automate data aggregation if needed, and (e) other relevant nontraditional data sources to augment information on intermediary organizations.

Stakeholders interview

From February to April of 2019, the research team interviewed 204 ecosystem stakeholders in six major cities in Japan (see table A.1 and table A.2). The stakeholders represent 110 organizations, including start-ups, accelerators and incubators, collaborative spaces, big companies, VC firms, capacity builders, universities, and government agencies.

Table A.1:
Number of Organizations and Individuals Interviewed, by Category of Stakeholder

Category	# of organizations	# of individuals
Company	19	33
Collaborative space	19	27
Start-up	19	21
Government	15	52
Other	11	18
University	11	24
VC	10	15
Accelerator/ Incubator	6	14
Total	110	204

Source: Author's analysis. / Note: VC = venture capital.

Table A.2:
Location of Interviewees

Location where most interviewees' activities are conducted	# of interviewees
Greater Tokyo area	107
Kyoto	32
Osaka	23
Fukuoka	17
Kobe	14
Nagoya	8
International (outside Japan)	3
Total	204

Source: Author's analysis.

Full list of interviewed organizations

01Booster
Accenture Japan Ltd
Aichi Prefectural Government
Amazon Web Services Japan K.K.
Ateam Inc.
Atmoph
Beyond Next Ventures
Borderless Japan
Cabinet Office, Government of Japan
Capital Technology LLC
City of Kyoto
City of Nagoya
Colorado Frontier Consulting
Cosmic Cafe
Cots Cots, Limited
Create Future Here
CrossEffect, Inc.
Crowd Credit
Darma Tech Labs, Inc.
Deloitte Tohmatsu Venture Support Co., Ltd.
DRAPERNEXUS Ventures
EDGEOf, Inc.
Endeavour
FFG Venture Business Partners, Ltd.
FOODPICT
Foundation for Biomedical Research and Innovation at Kobe (FBRI)
Fukuoka City Government
Fukuoka-DC
Future Venture Capital
FVC Mesh KYOTO
f-Ventures
Global Innovation Conference ‘ Hack Osaka “ (Urban Innovation Institute)
Global Startup Centre
Gojo & Company, Inc.
Google Japan
GVH #5
Hankyu Hanshin Properties Corp.
Hitachi, Ltd.
Hitotsubashi University
Human Hub Japan Corp
Institute for a Global Society Corporation
Loftwork Inc.
Japan Aerospace Exploration Agency
Japan Innovation Network
Japan International Cooperation Agency (JICA)
Kansai Association of Corporate Executives
KNOWLEDGE CAPITAL Association
Kobe City Government
Kobe University
KURASERU
Kyoto Institute of Technology
Kyoto Makers Garage
Kyoto Research Park Corp
Kyoto University
Kyoto University Innovation Capital (“KYOTO-ICAP”)
Kyushu University
Le Wagon
Life Science Innovation Network Japan, Inc
Makers Bootcamp (Monozukuri Ventures)
Mass Mass Kannai Future Center
McKinsey & Company, Inc. Japan
Ministry of Economy, Trade and Industry (METI)
Mitsubishi Corporation
MITSUBISHI ESTATE
MTRL KYOTO (FabCafe)
Mui Lab, Inc
Nagoya University
National Graduate Institute for Policy Studies
New Energy and Industrial Technology Development Organization
nijo, Inc.
Nikkei Inc.
NISSAN MOTOR CORPORATION
Open City Institute, Co Ltd,
Osaka City Government
Osaka Innovation Hub
Osaka Innovation Hub
Osaka University
Phoenixi Co., Ltd.
Plan International Japan
Platin
Plug and Play
Qurate Inc.
Raksul
Rakuten, Inc.
Region Works LLC
Sansan
SBI Investment Co., Ltd
Science and Technology Agency
Shibuya Government
SLUSH Tokyo

SoftBank
SOGO
Star and Stories
Startup Guide
STARTUP HUB TOKYO
Sun Bridge Global Ventures, Inc.
Taiwan Tech Arena
Techstars
The Japan Research Institute, Ltd.
The Kobe Shimbun
The University of Tokyo
The University of Tokyo Edge Capital Co, Ltd.
Tohoku University
Tokyo Metropolitan Government
Tokyo SME Support Center
Umitron Pte., Ltd.
WASSHA
WeWork
World Innovation Lab (WIL)

The majority of interviews were face-to-face, and a small number were conducted by phone. Each interview was based on standard questions designed by the research team and was extended with follow-up questions when applicable. Interviews were conducted in Japanese and English. The standard questions included the following:

1. Introduce yourself: name, title, organization.
2. Introduce the things/programs you are doing.
3. Who are your main stakeholders?
4. For policy makers: what kind of policies does the city have to support a start-up ecosystem?
5. What do you think of the start-up ecosystem of this city?
    a. What are the gaps in the start-up ecosystem?
    b. Which things/programs/policies are doing well? Any good examples?
    c. Which are not doing well? What's the challenge?
6. What are your recommendations/priorities to improve the start-up ecosystem of this city?

Desktop data collection

This report uses secondary data sources, complemented by some primary data. The sources are specified in each section. The main data sources used for the analysis were compiled through a survey of Japanese start-up founders and ecosystem stakeholders, which was conducted by the Cabinet Office under the guidance of the World Bank team. The first data set contains information on 3,914 start-ups, which are in Tokyo, Kansai (Hyogo, Kyoto, and Osaka), and Fukuoka. This data set has information about each company's founding year, address, type of business, founder's information (such as education and previous jobs), and the associated investors and accelerators. The second data set contains information on 65 accelerator programs, their management entities, their supporting entities, the type of accelerator, and associated start-ups and mentors.

These data sets are mainly based on the INITIAL (https://initial.inc/) data and were complemented by the following databases:

- Startup DB (https://startup-db.com/)
- SPPEDA (https://www.ub-speeda.com/)
- Seed Accelerator Rankings Project (http://seedrankings.com/)

When the start-ups' information was not complete in the previous databases, the data were complemented by looking at the following specific sources:

- Individual start-up and accelerators' websites
- LinkedIn founders' and companies' profiles

In the case of international comparisons, the main databases used were:

- PitchBook (https://pitchbook.com/)
- CBInsights (https://www.cbinsights.com/)
- Crunchbase (https://www.crunchbase.com/)
- Tracxn (https://tracxn.com/)
- Dealroom.co (https://dealroom.co/)

Start-up founders survey

To complement the previous data, the World Bank research team developed a survey to assess start-up funders' opinions about the biggest challenges the companies are facing; the time required to do certain tasks; their international focus; and the main criteria identified to pursue a venture. The survey was conducted by the Cabinet Office from November 2019 to March 2020.

The following questions were asked:

1. Please enter the number of days to do the following tasks:

- Raise capital/funding needed to start your business
- Hire an employee, from job posting to employee start
- Obtain office space for your start-up

2. Select the three biggest challenges that you are currently facing:

- Fundraising
- Marketing
- Recruiting
- Training of employees
- Regulation, product development (research and development)
- Competition
- Others

3. How important are the following criteria when evaluating whether to pursue a venture?

- Size of market/opportunity
- Profitability
- Social impact
- Ease of validation (product/market fit)
- Existing relationships/Access to potential customers
- Personal passion
- Skill set
- Access to financing
- Regulatory/legal environment
- Understanding and family support
- Safety net

4. Global vs. domestic

- Does your start-up operate in Japan only?
- Do you have plans to operate internationally in the next two years?
- Does your company have an English website?

The participants of this survey were contacted by email and telephone. The Cabinet Office survey leveraged J-Startups (https://www.j-startup.go.jp/) and the Deloitte Morning Pitch event for contacting the companies. Additionally, INCJ provided its contacts as well. Once the start-ups' funders were contacted, the questionnaire was sent via email.

The respondent rate is presented in table A.3.

Table A.3:
Survey Response Rate per Location of Stakeholder

	Tokyo	Kansai	Fukuoka	Total
Response	471	48	15	534
Target	3,515	330	69	3,914
Response rate (%)	13.4	14.5	21.7	13.6

Source: Author's analysis.

DATA PIPELINE

The data sets used in this report were compiled in Excel files and further transformed into comma-separated values files. Every entity of the analysis (start-ups, schools, investors, accelerators and supporting infrastructure, and previous jobs) included its address. This information was geocoded using Google Maps API to obtain standardized location data for conducting the spatial analysis.

Ones all the aforementioned information was compiled, new data sets were created. The new data sets were deduplicated using a process that marked similarities between names and URLs. This process was conducted automatically and double-checked manually. The inconsistencies found were corrected and double-checked manually. Entities that were determined to be likely duplicates were then merged, maintaining all existing data and privileging more recent data in the event of conflict. Duplicate nodes and edges (for the networks analysis) resulting from this process were removed. From this cleaned and augmented data set, panel and graph data were then generated for analysis.

Analysis

The main data analysis done in this report can be divided in two sections: (a) network and community analysis to understand how different components in the ecosystem are connected and interact, and (b) spatial analysis to identify how the entities analyzed are distributed in the physical space.

Networks and community analysis

The stakeholders (or entities) in the Japan start-up ecosystem can be represented using a network composed of nodes (companies, investors, supporting infrastructure/accelerators, schools, and mentors) and edges, which are the relationships between nodes. For the network analysis, an edge was considered to be part of an ecosystem if either of its endpoints was in the region. From these edges, the relevant nodes for the network were extracted. Technically, the network is multipartite. For the purpose of our analysis, we created different networks (table A.4 and table A.5).

Table A.4:
Reference of Data Sets Used of the Geographical and Social Networks of Tokyo and Japan Ecosystems

Ecosystem	Data set	Figure
Geographic start-up activity concentration in Japan	Survey and enriched data from Japan	Figure 1.9
Tokyo start-up ecosystem´s social network: main influential actors by category	Survey and enriched data from Japan	Figure 2.4
Ecosystem network of "specialized" and "nonspecialized" actors	Survey and enriched data from Japan	Figure 3.1
Top Tokyo independent VC investment networks	Survey and enriched data from Japan	Figure 3.2
Top CVCs investment networks	Survey and enriched data from Japan	Figure 3.8
Ecosystem network of specialized and nonspecialized support infrastructure actors	Survey and enriched data from Japan	Figure 4.1
Ecosystem's network of angel investors	Survey and enriched data from Japan	Figure 4.2
Ecosystem network of formal (for instance, universities) and informal (for instance, start-up specialized actors) skills infrastructure actors	Survey and enriched data from Japan	Figure 5.1
Start-up founders in Tokyo ecosystem distributed by university	Survey and enriched data from Japan	Figure 5.4

Source: Author's analysis.
Note: CVC = corporate venture capital; VC = venture capital.

Table A.5:
Reference of Data Sets Used in the International Connectivity

Ecosystem	Data set	Figure
International connectivity deep-tech start-ups and investors among start-up hubs	PitchBook database and World Bank's research	Figure 2.6

Source: Author's analysis.

Calculating the centrality measures on these networks builds understanding of which players in the ecosystem are the most influential and provide a wider connectivity and access to knowledge and resources to their clusters. In our analysis, two centrality measures were used: degree centrality and eigenvector centrality:

- Degree centrality measures the number of other nodes within the ecosystem to which each node is directly connected. It does not consider any second-order connections.
- Eigenvector centrality augments degree centrality by considering the connectivity of the nodes to which a node is connected. Highly connected nodes within highly interconnected clusters have high eigenvector centrality.

All the results can be observed in the following table A.6.

Table A.6:
Reference of Social Network Analysis Results (Degree Centrality and Eigenvector Centrality)

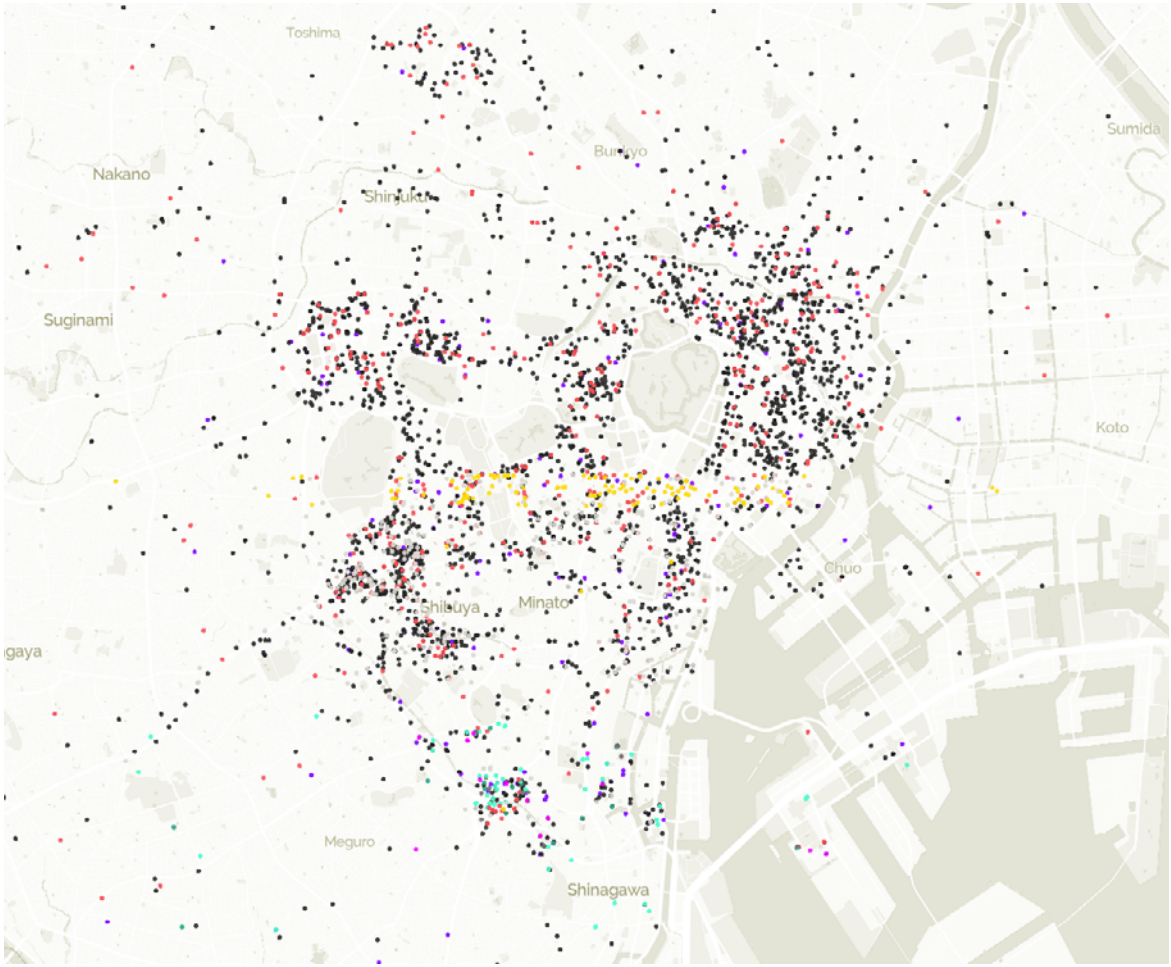
Network	Results table	Figure
Tokyo start-up ecosystem´s social network: main influential actors by category	Table B.3	Figure 2.4
Ecosystem network of specialized and nonspecialized actors	Table B.4 and Table B.5	Figure 2.5
Top Tokyo independent VC investment networks	Table B.6	Figure 3.2
Top CVCs investment networks	Table B.7	Figure 3.8
Ecosystem network of specialized and nonspecialized support infrastructure actors	Table B.8 and Table B.9	Figure 4.1
Ecosystem's network of angel investors	Table B.10 and Table B.11	Figure 4.2
Ecosystem network of formal (for instance, universities) and informal (for instance, start-up specialized actors) skills infrastructure actors	Table B.12 and Table B.13	Figure 5.1
Start-up founders in Tokyo ecosystem distributed by university	Table B.14	Figure 5.4
International connectivity deep-tech start-ups and investors among start-up hubs	Table B.15	Figure 2.6

Source: Author's analysis.
Note: CVC = corporate venture capital; VC = venture capital.

Spatial analysis and mapping

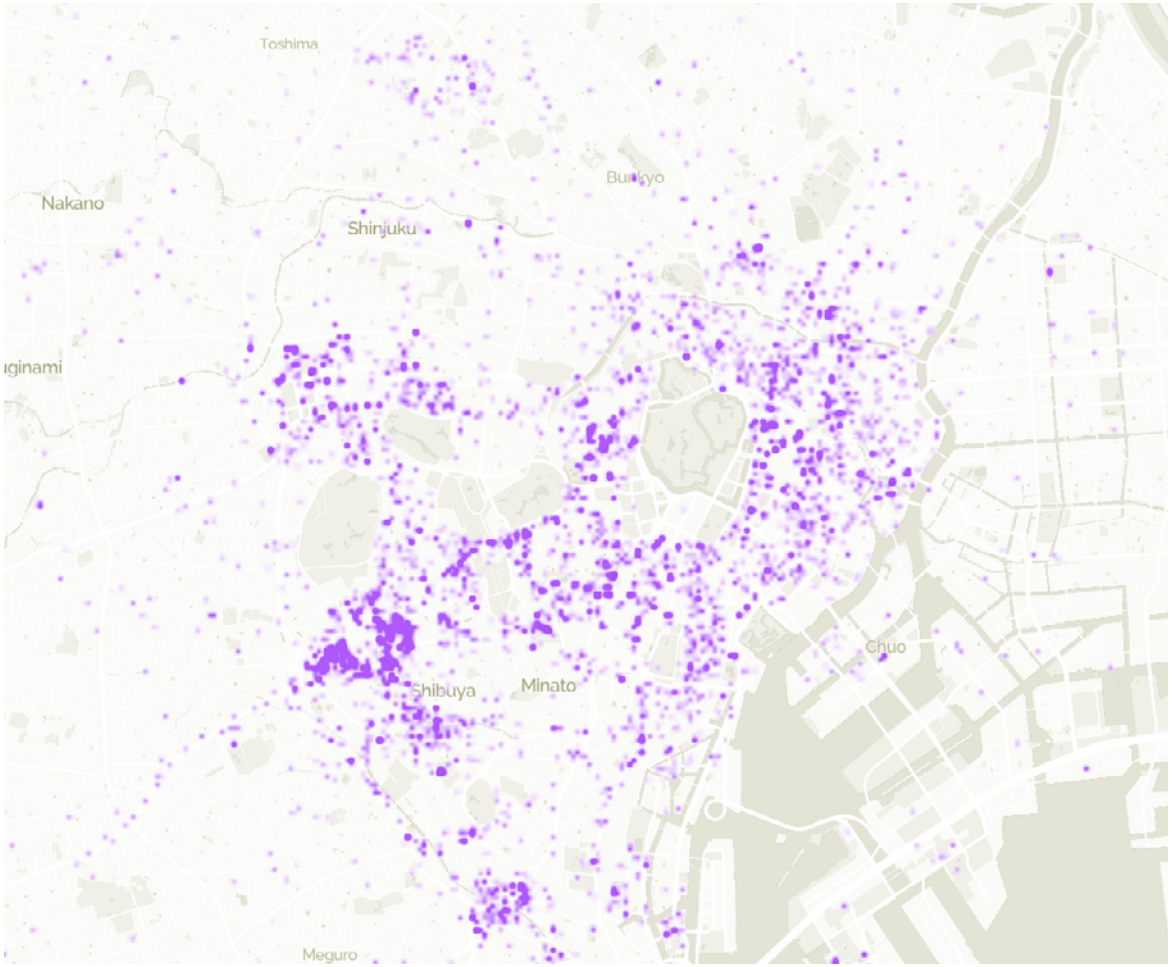
The spatial analysis helps us to assess how the different entities are located within the Japanese territory and are useful to understand patterns (special colocation), which are key for understanding how the communities can be developed. On the basis of the georeferenced data that we obtained by using Google Maps API, we plot all the locations and then we assess the kernel density to find geographical concentration of entrepreneurial activity. Using this measurement, we developed two maps (map A.1 and map A.2).

Map A.1:
Geographic Distribution of All Entities in Tokyo



Source: Authors' analysis.
Note: Map A.1 is available at http://japan.data593.com/MAP_JAPAN_TOTAL.html.

Map A.2:
Kernel Density of All Entities in Tokyo



Source: Authors' analysis.
Note: Map A.2 is available at https://japan.data593.com/MAP_DENSITY_TOKYO.html.

Exchange Rates

All dollar amounts are U.S. dollars unless otherwise indicated. When amounts are not provided in US$, exchange rate conversation is done by applying the provided year's exchange rate from the Organisation for Economic Co-operation and Development Exchange rates (OECD 2021) (indicator), doi:10.1787/037ed317-en (accessed May 2021).

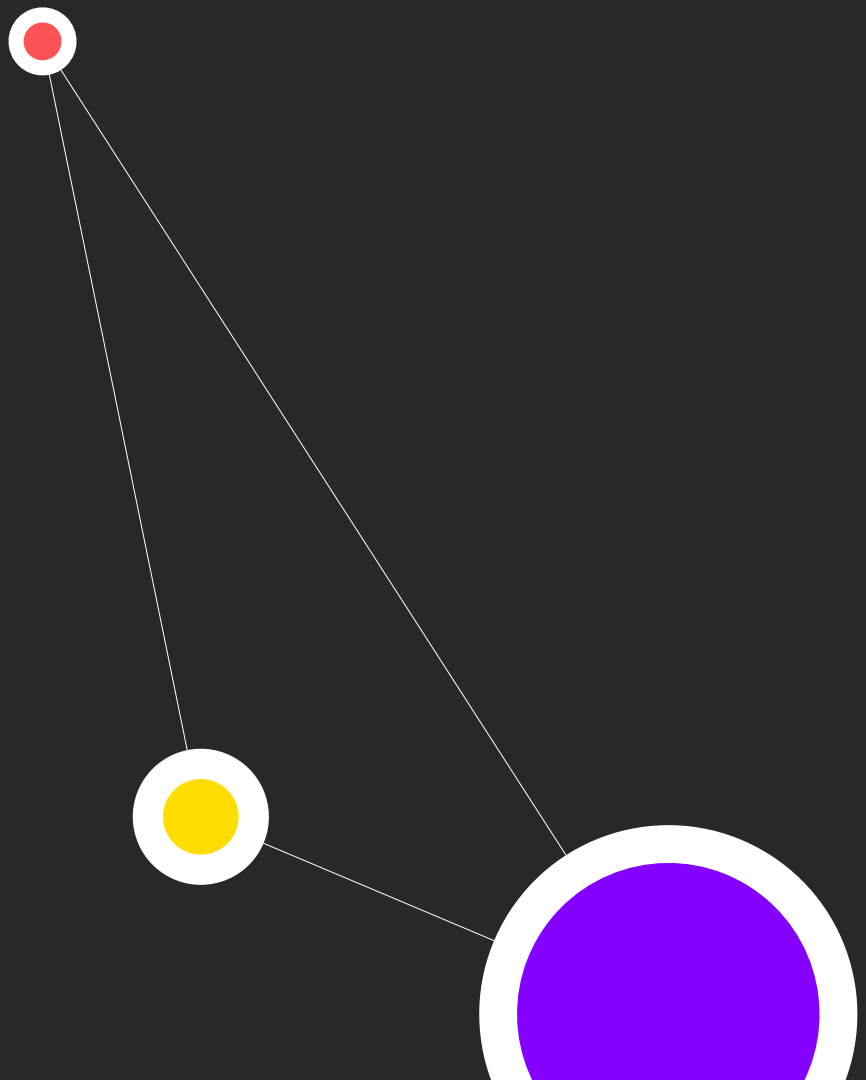
LIMITATIONS

Our data sources are mainly secondary, complemented with some primary data. The data used was provided by reputable organizations such as INITIAL, PitchBook, CBInsishts, Cruchbase, Dealroom.co, Tracxn, Startup Genome, and others. The diversity of secondary sources allowed for an additional layer of validation of data among these multiple databases. Using this combination of data established a degree of validity and reliability, which was enriched by the team involved. For instance, the Cabinet Office survey collected data based on INITIAL, and these data were complemented using its own databases. However, this procedure could generate a sort of selection bias focusing on the start-ups that were known by the company, leaving others aside. Also, the data sources depend on commercial start-up databases, relying mainly on their press releases; start-ups that have fundraised with a positive attitude, as conveyed in their press releases, could be overrepresented. Therefore, the representativeness of the sample is limited.

Our analysis is highly influenced by survivorship bias. Entrepreneurs that are not successful in the ecosystem are usually not captured in many proprietary and non-proprietary data sources. For example, a weak signal for serial entrepreneurs may suggest not that people do not repeatedly start businesses, but that once they have had one start-up, they pursue subsequent start-ups in other, more developed ecosystems. Currently, there is no way to capture data on those individuals who leave, or to identify them in our data sets. In addition, our data capture only entrepreneurs who were active until the information was obtained, and as such it does not capture failed entrepreneurs who have dropped out of the ecosystem. To complement this analysis, it is suggested that one try to understand the reasons that some start-ups fail in the Japanese ecosystem.

Limited comparability between data sources may also influence our analysis. The two most important data sets (start-ups and accelerators/mentors) that were used in this analysis cannot be compared or merged completely, because some accelerators were not included in the first data set and vice versa. During the cleaning phase of our data, most of these issues were overcome, but some mismatching still exists, which might influence our core findings. In the case of the comparison with the New York City's ecosystems, the data source was compiled with a different set of tools and the sample is different. The comparison must be treated with caution.

The sample used might be outdated, and some misclassification bias could exist. Most of the existing data sources available have a lag of two to three years. This is mainly because of the time the companies take to prepare or deploy the respective surveys. Also, the data enrichment done by our team relies on the data provided by the websites of every entity. We worked under the assumption that all the entities' public information is up to date. Finally, during the cleaning process, we found some classification errors between investors and accelerators or other supporting infrastructure. This was cleaned manually, but small misclassification errors could still exist.



Appendix B

Data

Table B.1:
Unicorn Clusters per Country or Economic Region

Country/economy	> 10 unicorn	Metropolitan areas	> 5 unicorn	Metropolitan areas
United States	5	San Francisco, New York, Boston, Los Angeles, Seattle	12	San Francisco; New York; Boston; Los Angeles; Seattle; Chicago; San Diego; Washington, DC; Atlanta; Denver; Salt Lake City; Austin
China	4	Beijing, Shanghai, Hangzhou, Shenzhen	6	Beijing, Shanghai, Hangzhou, Shenzhen, Guangzhou, Hong Kong
European Union	2	London, Berlin	5	London, Berlin, Paris, Amsterdam, Munich
India	2	Bangalore, New Delhi	2	Bangalore, New Delhi
United Kingdom	1	London	1	London
Germany	1	Berlin	2	Berlin, Munich
Republic of Korea	1		1	Seoul
Israel	0		1	Tel Aviv
Japan	0		1	Tokyo
France	0		1	Paris
Singapore	0		1	Singapore

Sources: CBInsights, 2021; INITIAL, 2021.

Table B.2:
Unicorns in Japan

Company	Sector	Year founded	HQ city
Preferred Networks	Artificial intelligence (AI)/ machine learning (ML)	2014	Tokyo
Clean Planet	Cleantech	2012	Tokyo
Quoine (Liquid)	Fintech (Cryptocurrency/Blockchain)	2014	Tokyo
TBM (Limex)	Material tech (Advanced Materials)	2011	Tokyo
SmartNews	SaaS	2012	Tokyo
Spiber	Material tech	2007	Tsuruoka
TRIPLE-1	Blockchain	2016	Fukuoka
Mercari	E-commerce	2013	Tokyo
NEXON	Internet	2002	Tokyo
Freee	SaaS, Finance	2012	Tokyo
Sansan	SaaS	2007	Tokyo

Sources: CBInsights, 2021; INITIAL, 2021.
Note: HQ = headquarters; SaaS = Software as a Service.

Table B.3:
Tokyo Start-up Ecosystem's Social Network: Main Influential Actors, by Category

Label	Type	Eigencentrality	Degree Centrality
SMBC Venture Capital	I	1	213
Mizuho Capital	I	0.947069	200
Mitsubishi UFJ Capital	I	0.893303	201
SBI Investment	I	0.675403	155
University of Tokyo	U	0.592123	204
Keio University	U	0.508934	199
Global brain	I	0.489078	135
Jafco	I	0.481029	143
Nissay Capital	I	0.393293	119
Incubate fund	I	0.385835	110
Waseda University	U	0.3616	174
Daiwa Corporate Investment	I	0.322031	98
Japan Finance Corporation	I	0.309188	79
Japan Venture Capital	I	0.306301	105
Sumitomo Mitsui Marine Capital	I	0.305998	79
East Ventures	I	0.304129	89
WealthNavi Co., Ltd.	C	0.28614	21
INCJ	I	0.282057	76
Globis Capital Partners	I	0.257172	78
DBJ Capital	I	0.25145	65
SPARX Group	I	0.248872	62
Wil LLC.	I	0.246574	46
YJ Capital	I	0.245438	61
Astro Scale Holdings Co., Ltd.	C	0.236924	18
Pixie Dust Technologies, Inc.	C	0.23365	19
Unifa Co., Ltd.	C	0.225833	22
Legimune	C	0.222474	23
Kotaro Chiba	I	0.219256	69
Money Tree Co., Ltd.	C	0.214618	17
Cyber Agent Capital	I	0.214152	71

Source: Authors' analysis
Note: C = company (including start-ups); I = investor; U = university

Table B.4:
Ecosystem Network of Specialized and Nonspecialized Actors, Tokyo

Label	Type	SP/NS	Eigencentrality	Degree Centrality
SMBC Venture Capital	I	NS	1	213
Mizuho Capital	I	NS	0.947069	200
Mitsubishi UFJ Capital	I	NS	0.893303	201
SBI Investment	I	NS	0.675403	155
University of Tokyo	U	NS	0.592123	204
Keio University	U	NS	0.508934	199
Global brain	I	SP	0.489078	135
Jafco	I	SP	0.481029	143
Nissay Capital	I	NS	0.393293	119
Incubate fund	I	SP	0.385835	110
Waseda University	U	NS	0.3616	174
Daiwa Corporate Investment	I	NS	0.322031	98
Japan Finance Corporation	I	NS	0.309188	79
Japan Venture Capital	I	SP	0.306301	105
Sumitomo Mitsui Marine Capital	I	NS	0.305998	79
East Ventures	I	SP	0.304129	89
WealthNavi Co., Ltd.	C	ST	0.28614	21
INCJ	I	NS	0.282057	76
Globis Capital Partners	I	SP	0.257172	78
DBJ Capital	I	NS	0.25145	65
SPARX Group	I	SP	0.248872	62
Wil LLC.	I	SP	0.246574	46
YJ Capital	I	NS	0.245438	61
Astro Scale Holdings Co., Ltd.	C	ST	0.236924	18
Pixie Dust Technologies, Inc.	C	ST	0.23365	19
Unifa Co., Ltd.	C	ST	0.225833	22
Legimune	C	ST	0.222474	23
Kotaro Chiba	I	SP	0.219256	69
Money Tree Co., Ltd.	C	ST	0.214618	17
Cyber Agent Capital	I	SP	0.214152	71

Source: Authors' analysis
Note: C = company; I = investor; NS = nonspecialized stakeholder; SP = specialized stakeholder; ST = start-up; U = university.

Table B.5:
Ecosystem Network of Specialized and Nonspecialized Actors, New York City

Label	Type	SP/NS	Eigencentrality	Degree centrality
Columbia University	U	NS	1	167
Sv Angel	I	SP	0.898977	82
Lerer Ventures	I	SP	0.802485	85
Harvard University	U	NS	0.762392	138
David Tisch	AN	SP	0.748852	69
New York University	U	NS	0.748851	136
University of Pennsylvania	U	NS	0.726159	113
BoxGroup	I	SP	0.631028	57
Flatiron Health	ST	ST	0.602162	67
Founder Collective	I	SP	0.584	58
Techstars	AC	SP	0.562619	71
First Round Capital	I	SP	0.551829	61
Rre Ventures	I	SP	0.550593	72
Adam Rothenberg	AN	SP	0.455282	37
Warby Parker	ST	ST	0.447439	49
Groupme	ST	ST	0.436389	29
Betaworks	AC	SP	0.406681	43
42Floors	ST	ST	0.394467	48
Softbank Capital	I	SP	0.364519	46
Behance	ST	ST	0.362736	31
Moat	ST	ST	0.362636	41
Memoir	ST	ST	0.361439	21
Buzzfeed	ST	ST	0.360054	28
Kohort	ST	ST	0.346617	51
Draper Fisher Jurvetson	I	SP	0.342415	45
Yipit	ST	ST	0.338118	35
David Cohen	AN	SP	0.336207	30
Chatid	ST	ST	0.335925	24
Amicus	ST	ST	0.328211	36
Pickie	ST	ST	0.326729	30

Source: Authors' analysis.
Note: AC = accelerator; AN = angel; I = investor; NS = nonspecialized stakeholder; SP = specialized stakeholder; ST = start-up; U = university.

Table B.6:
Top Tokyo Independent VC Investment Networks

Label	Type	SP/NS	Eigencentrality	Degree Centrality
Jafco	I	SP	1	143
Global brain	I	SP	0.85829	135
Incubate fund	I	SP	0.617641	110
East Ventures	I	SP	0.54087	89
Japan Venture Capital	I	SP	0.503642	105
Globis	I	SP	0.417133	78
Wil LLC.	I	SP	0.245854	46
Mitsubishi UFJ Capital	I	NS	0.240504	31
Visional Co.	C	ST	0.23911	18
Mizuho Capital	I	NS	0.227027	28
SMBC Venture Capital	I	NS	0.210836	29
Baseconnect Co.	C	ST	0.200792	19
C Channel Co.	C	ST	0.197385	19
Cyfuse Co.	C	ST	0.191229	21
medley	C	ST	0.187539	4
CAMPFIRE	C	ST	0.178405	3

Label	Type	SP/NS	Eigencentrality	Degree Centrality
WonderPlanet Co.	C	ST	0.178262	3
Astro Scale Co.	C	ST	0.176016	17
Speak Buddy Co.	C	ST	0.172088	10
Mirrativ Inc.	C	ST	0.169906	3
Photosynth Inc.	C	ST	0.169906	3
TIMERS Inc.	C	ST	0.168094	10
SBI Investment	I	NS	0.166089	25
Dely	C	ST	0.165492	16
Gumi Co.	C	ST	0.16299	3
akippa Co.	C	ST	0.162534	14
Chordia Therapeutics Co.	C	ST	0.155681	6
BASE	C	ST	0.155667	12
Open Eight Co.	C	ST	0.154491	3
au Commerce & Life	C	ST	0.139999	4
ClipLine Co.	C	ST	0.139326	12

Source: Authors' analysis.
Note: C = company; I = investor; NS = nonspecialized stakeholder; SP = specialized stakeholder; ST = start-up; VC = venture capital.

Table B.7:
Top CVCs Network, Tokyo

Label	Type	SP/NS	Eigencentrality	Degree Centrality
YJ Capital	I	NS	1	61
NTT Docomo Ventures	I	NS	0.980892	62
ITOCHU Technology Ventures	I	NS	0.573207	40
GMO Venture Partners	I	NS	0.539709	42
KDDI Open Innovation Fund	I	NS	0.501969	47
Kaizen Platform Co.	C	ST	0.432741	17
Retty Co.	C	ST	0.289665	3
Repro Co.	C	ST	0.285398	3
Chat Book Co.	C	ST	0.277838	16
Subsclife Co.	C	ST	0.266601	12
TIMERS Inc.	C	ST	0.256474	10
RAKSUL INC.	C	ST	0.244881	3
Money Design Co.	C	ST	0.244881	3
Kakehashi Co.	C	ST	0.240043	19
Emotion Tech Inc.	C	ST	0.234615	13
Photosynth Inc.	C	ST	0.221695	2
Liquid	C	ST	0.213571	18
toBe Marketing Co.	C	ST	0.201333	8
Mizuho Capital	I	NS	0.196242	7
Axelspace Corporation	C	ST	0.190333	19
SMBC Venture Capital	I	NS	0.188031	7
Mirrativ Inc.	C	ST	0.17924	2
Yappli Co.	C	ST	0.17924	2
Fringe81 Co.	C	ST	0.178395	2
Xica	C	ST	0.178395	2
Money Forward Co.	C	ST	0.177008	15
FreakOut Co.	C	ST	0.17691	2
Hitokuse Co.	C	ST	0.17691	2
Uzabase Co.	C	ST	0.17691	2

Source: Authors' analysis.
Note: C = company; CVCs = corporate venture capital; I = investor; NS = nonspecialized stakeholder; SP = specialized stakeholder; ST = start-up.

Table B.8:
Ecosystem Network of Specialized and Nonspecialized Support Infrastructure Actors, Tokyo

Label	Type	SP/NS	Eigencentrality	Degree centrality
Plug and Play Japan	A	NS	1	79
Kotaro Chiba	I	SP	0.802639	69
Industry Co-Creation	A	SP	0.76366	64
Fujitsu Accelerator Program	A	NS	0.695374	58
METI	A	NS	0.61873	64
NEDO	A	NS	0.609156	73
Tech Planter	A	NS	0.585682	60
AI.Accelerator	A	SP	0.533305	57
Future Co-creation Innovation Network (INCF)	A	NS	0.523234	52
Orange Fab Asia	A	NS	0.417347	41
Yusuke Sato	I	SP	0.41588	38
Tokyu Accelerate Program	A	NS	0.391775	40
HoloEyes	ST	ST	0.381265	8
OIH Seed Acceleration Program	A	NS	0.341102	51
Incubate Camp	A	SP	0.332969	37
TRIBUS-RICOH	A	NS	0.320207	43
KDDI ∞ Labo	A	NS	0.317756	34
Aoyama Start-up Acceleration Program	A	NS	0.310734	33
Nobarusu Co., Ltd.	ST	ST	0.309822	9
Ayataro Nakagawa	I	SP	0.306793	29
Open Network Lab	A	SP	0.299829	44
inaho Co., Ltd.	ST	ST	0.287229	7
Voicy Co., Ltd.	ST	ST	0.282224	7
Yu Akasaka	I	SP	0.268582	33
CLUE Co., Ltd.	ST	ST	0.263781	5
Aten Lab Co., Ltd.	ST	ST	0.263365	6
Azit Inc.	ST	ST	0.260967	8
WAmazing Co., Ltd.	ST	ST	0.260018	7
EY Innovative Start-up	A	NS	0.258278	36
MAMORIO Co., Ltd.	ST	ST	0.251514	8

Source: Authors' analysis.
Note: A = accelerator; I = investor; NS = nonspecialized stakeholder; SP = specialized stakeholder; ST = start-up.

Table B.9:
Ecosystem Network of Specialized and Nonspecialized Support Infrastructure Actors, New York City

Label	Type	SP/NS	Eigencentrality	Degree centrality
David Tisch	I	SP	1	69
Techstars	A	SP	0.744102	71
Adam Rothenberg	I	SP	0.65177	37
Betaworks	A	SP	0.620974	73
Flatiron Health	ST	ST	0.601101	56
Entrepreneurs Roundtable Accelerator	A	SP	0.553399	64
David Cohen	I	SP	0.499214	30
General Assembly	A	SP	0.43608	62
Lua Technologies	ST	ST	0.418433	30
Patentory	ST	ST	0.41804	28
500 Startups	A	SP	0.399941	41
42Floors	ST	ST	0.378377	30
Lua	ST	ST	0.371939	27
Charlie Kemper	I	SP	0.37101	31
Fatih Ozluturk	I	SP	0.365631	24
Behance	ST	ST	0.361587	24
Murat Aktihanoglu	I	SP	0.339653	23
Centrl	ST	ST	0.339653	23
Karma Mobility	ST	ST	0.331917	19
Chatid	ST	ST	0.331831	18
Poptip	ST	ST	0.329953	20
Bondsy	ST	ST	0.328559	12
Numberfire	ST	ST	0.327782	18
Kohort	ST	ST	0.326353	34
Dave McClure	I	SP	0.319769	22
Bespoke Post	ST	ST	0.315629	23
Pickie	ST	ST	0.310635	19
Lore	ST	ST	0.309	15
Amicus	ST	ST	0.293259	25
Chris Dixon	I	SP	0.290974	23

Source: Authors' analysis
Note: A = accelerator; I = investor; NS = nonspecialized stakeholder; SP = specialized stakeholder; ST = start-up.

Table B.10:
Ecosystem Network of Specialized and Nonspecialized Support Infrastructure Actors, Tokyo

Label	Type	Eigencentrality	Degree centrality
Kotaro Chiba	I	1	69
Yusuke Sato	I	0.64849	38
Ayataro Nakagawa	I	0.508423	29
Yu Akasaka	I	0.413494	33
Kensuke Furukawa	I	0.337223	24
Luup Co.	ST	0.337072	8
Kazuma Ieiri	I	0.32623	29
Lang-8 Co.	ST	0.32036	7
FIREBUG Co.	ST	0.282399	7
Smart Round Co.	ST	0.272861	8
Hidetoshi Takano	I	0.25299	28
Giraffe Co.	ST	0.229424	6
CLUE Co., Ltd.	ST	0.22119	3
Lovegraph	ST	0.220502	3
Voicy Co., Ltd.	ST	0.219875	4
Nobuhiro Ariyasu	I	0.207329	20
Dely	ST	0.206397	5
Aidemy Inc.	ST	0.205226	4
Azit Inc.	ST	0.204069	5
Wondershake Co., Ltd.	ST	0.19651	5
Graffity Co.	ST	0.193635	5
10x	ST	0.192559	5
Yoshinori Fukushima	I	0.191713	15
RINACITA	ST	0.189757	4
Kim Yasushi	I	0.181572	17
FUN UP Co., Ltd.	ST	0.179989	3
Tripbox	ST	0.178998	4
Shunsuke Oyu	I	0.177946	11
Hackjpn	ST	0.170114	3
Yusuke Mitsumoto	I	0.168895	10

Source: Authors' analysis.
Note: I = investor (angel); ST = start-up.

Table B.11:
Ecosystem's Network of Angel Investors, New York City

Label	Type	Eigencentrality	Degree centrality
David Tisch	I	1	69
Flatiron Health	ST	0.660929	56
Adam Rothenberg	I	0.620196	37
David Cohen	I	0.442443	30
Lua	ST	0.408185	27
42Floors	ST	0.400353	29
Lua Technologies	ST	0.362041	28
Behance	ST	0.352477	23
Kohort	ST	0.347253	34
Patentory	ST	0.315842	27
Fatih Ozluturk	I	0.308172	24
Chris Dixon	I	0.303311	23
Chatid	ST	0.299968	17
Warby Parker	ST	0.299908	32
Bonobos	ST	0.299038	46
Charlie Kemper	I	0.296413	31
Dave McClure	I	0.295914	22
Launchrock	ST	0.292385	36
Poptip	ST	0.288542	19
Murat Aktihanoglu	I	0.283571	23
Centrl	ST	0.283571	23
Lore	ST	0.28158	14
Nat Turner	I	0.28034	17
Zach Weinberg	I	0.267696	16
Numberfire	ST	0.261624	16
Blue Apron	ST	0.253374	10
Days by Wander	ST	0.253364	18
Rewind.Me	ST	0.250278	20
Karma Mobility	ST	0.249062	16
Sunrise	ST	0.246531	30

Source: Authors' analysis.
Note: I = investor (angel); ST = start-up.

Table B.12:
Ecosystem Network of Formal (Universities) and Informal (Start-up Specialized Actors) Skills Infrastructure Actors, Tokyo

Label	Type	SP/NS	Eigencentrality	Degree centrality
University of Tokyo	U	NS	1	204
Keio University	U	NS	0.911396	198
Waseda University	U	NS	0.681815	173
Plug and Play Japan	AC	NS	0.285656	79
Industry Co-Creation	AC	SP	0.257021	64
Kyoto University	U	NS	0.23976	95
Fujitsu Accelerator Program	AC	NS	0.213913	58
Future Co-creation Innovation Network (INCF)	AC	NS	0.192532	52
AI.Accelerator	AC	SP	0.18486	57
Tech Planter	AC	NS	0.165084	60
Orange Fab Asia	AC	NS	0.146054	41
Incubate Camp	AC	SP	0.129001	37
Aoyama Startup Acceleration Program	AC	NS	0.125237	33
Tokyu Accelerate Program	AC	NS	0.124305	40
Open Network Lab	AC	SP	0.123942	44
OIH Seed Acceleration Program	AC	NS	0.114009	51
Zenport Inc.	ST	ST	0.112454	6
EY Innovative Startup	AC	NS	0.10843	36
Meleap Inc.	ST	ST	0.108257	5
MET Grants	AC	NS	0.108126	33
BONX Co.	ST	ST	0.1073	5
WAmazing Co.	ST	ST	0.107296	5
H2L	ST	ST	0.106537	5
KDDI ∞ Labo	AC	NS	0.105378	34
Cell Fiber Co.	ST	ST	0.105347	5
Charenergy Co.	ST	ST	0.105079	5
Unirobot Co.	ST	ST	0.104821	5
L-Pixel Co.	ST	ST	0.10441	4
Azit Inc.	ST	ST	0.102151	4
Doctor Fellow Co.	ST	ST	0.101818	4

Source: Authors' analysis.
Note: AC = accelerator; NS = nonspecialized stakeholder; SP = specialized stakeholder; ST = start-up; U = university.

Table B.13:
Ecosystem Network of Formal (Universities) and Informal (Start-up Specialized Actors) Skills Infrastructure Actors, New York City

Label	Type	SP/NS	Eigencentrality	Degree centrality
Columbia University	U	NS	1	167
New York University	U	NS	0.696675	136
Harvard University	U	NS	0.671533	138
University of Pennsylvania	U	NS	0.54525	113
General Assembly	BC	SP	0.327485	59
Techstars	AC	SP	0.308101	71
Entrepreneurs Roundtable Accelerator	AC	SP	0.29781	64
Cornell University	U	NS	0.25376	75
Massachusetts Institute of Technology	U	NS	0.216501	63
Betaworks	AC	SP	0.207165	46
InSITE	ME	NS	0.204815	48
Projective Space	CW	SP	0.199673	45
Yale University	U	NS	0.197738	55
Flatiron Health	ST	ST	0.192596	46
Dreamit Ventures	AC	SP	0.18696	57
Patentory	ST	ST	0.179789	28
500 Startups	AC	SP	0.162205	41
Weespring	ST	ST	0.158269	5
Stanford University	U	NS	0.15819	48
TripleLift	ST	ST	0.149162	7
University of Michigan	U	NS	0.146455	43
Centrl	ST	ST	0.144883	23
Docphin	ST	ST	0.143251	5
First Growth Network	ME	SP	0.143082	33
Omgpop	ST	ST	0.141902	4
Upnext	ST	ST	0.141703	7
Skillslate	ST	ST	0.141122	5
Brown University	U	NS	0.139679	46
Payperks	ST	ST	0.134824	4
Covestor	ST	ST	0.133652	4

Source: Authors' analysis.
Note: AC = accelerator; BC = boot camp; CW = co-working space; ME = mentoring program; NS = nonspecialized stakeholder; SP = specialized stakeholder; ST = start-up; U = university.

Table B.14:
Start-up Founders in Tokyo Ecosystem, by University

University	Number of founders
University of Tokyo	161
Keio University	157
Waseda University	133
Kyoto University	73
Meiji University	31
Chuo University	25
Aoyama Gakuin University	25
Hosei University	24
Others	620

Source: Authors' analysis.

Table B.15:
International Connectivity Deep-Tech Start-ups and Investors Among Start-up Hubs

City	Country	Eigencentrality	Degree centrality
San Francisco	United States	1	222
New York	United States	0.817791	146
London	United Kingdom	0.724497	135
Boston	United States	0.647512	96
Los Angeles	United States	0.614809	78
Washington, DC	United States	0.537396	87
Paris	France	0.533584	93
Seattle	United States	0.492902	55
Tel Aviv	Israel	0.485795	61
Denver	United States	0.462498	62
Singapore	Singapore	0.459601	57
Austin	United States	0.437769	44
Beijing	China	0.435521	59
Tokyo	Japan	0.413919	51
Chicago	United States	0.410744	49

City	Country	Eigencentrality	Degree centrality
San Diego	United States	0.408006	36
Hong Kong	China	0.386622	41
Munich	Germany	0.36933	44
Shenzhen	China	0.362473	46
Shanghai-Hangzhou	China	0.352096	42
Zurich	Switzerland	0.344634	40
Philadelphia	United States	0.34333	32
Toronto	Canada	0.337854	37
Atlanta	United States	0.331162	33
Berlin	Germany	0.312656	37
Montreal	Canada	0.310049	33
Vancouver	Canada	0.297752	30
Seoul	Korea, Rep.	0.295779	26
Brussels	Belgium	0.295006	47
Amsterdam	Netherlands	0.294932	37

Source: Authors' analysis.

Glossary

Accelerator — Organizations that offer a range of support services and funding opportunities for start-ups, typically delivered over a months-long programs that offer mentorship, office space, and supply-chain resources. For types of accelerator programs, see box 4.1.

Angel investor — Investors who invest in ventures (primarily at an early stage) in their personal capacity (that is, investing their personal money) and may or may not have an active advisory or guidance role for the founders in the venture.

Boot camp — Intensive programs of software development, which can be operated in partnership with universities, provided online or in person, as well as niche areas such as data science and data engineering.

Centrality — Centrality measures show entities that have more connections with the other actors of the ecosystem (for example, start-ups, investors, supporting programs, and so forth) and how important those connections are and, therefore, have more influence in it. We consider centrality a positive characteristic of an organization and an indication of its role and value within an ecosystem.

Commercialization — Process of managing or running something principally for financial gain, oftentimes coming out of university or corporate research teams.

Corporate accelerator — Form of accelerator that is sponsored by an established for-profit corporation. Similar to regular accelerators in that they support early-stage start-up companies through mentorship and often capital and office space.

Corporate venture capital (CVC) — Investment of corporate funds directly in external startup companies, which often operate in the same industry as the corporation and therefore can bring strategic value.

Nonspecialized organizations — Corporate, university, government, and other programs that play a role in supporting start-ups and the ecosystem itself but are not specifically designed to work with entrepreneurs and their ventures.

Global city — Urban center with significant competitive advantages that serves as a hub within a globalized economic system.

Specialized organizations — Venture capital and other funds, accelerators, and other organizations in a start-up ecosystem that are not part of a corporate, government, or university entity and are often designed with the intent of specializing in start-up support.

Initial public offering (IPO) — The process by which a private company offers shares to the public, usually in a market exchange.

Innovation hub or cluster — Metropolitan area or conurbation with a high concentration of scientific knowledge and innovation outputs (for example, scientific publications and patents). (See Assumptions, Scope, and Objective for further details.)

Mentor — An experienced professional who can provide advice, knowledge, or connections to a start-up founder. Mentors usually have strong business acumen and practical experience through former entrepreneurship experience or industry knowledge.

Multinational corporation (MNC) — Large corporation incorporated in one country that produces or sells goods or services in various countries. Two common characteristics shared by MNCs are their large size and the fact that their worldwide activities are centrally controlled by the parent companies.

Research and development (R&D) — Work directed toward the innovation, introduction, and improvement of products and processes, often coming out of universities, corporations, governments, or dedicated R&D centers.

Social network — Social networks are informal connections and communities of actors and organizations in a start-up ecosystem that support the identification of entrepreneurial opportunities, access to finance, and access to information; also, networks support the creation of resource effects and spillovers, as well as strategic alliances and status signaling.

Start-up — For-profit business ventures that (a) have a financial model that can achieve high growth and (b) employ an innovative and technology-enabled

approach to the product or service that they provide to ensure scalability. These ventures may or may not be profitable at the current stage.

Start-up ecosystem — The combination of people, start-ups at various stages, and other stakeholders and organizations supporting or connecting to these start-ups and interacting in multiple dimensions to create and scale new start-up ventures. (See Assumptions, Scope, and Objective for further details.)

Support infrastructure — Organizations that provide some elements of nonfinancial support to start-ups in the form of acceleration and incubation, mentorship, partnership connections, or other forms of support.

Skills infrastructure — Organizations that help to develop entrepreneurial behaviors and other skill sets that would be relevant for creating and running start-ups. Coding academies, start-up boot camps, and specialized entrepreneurship education programs in universities are all examples of entities comprising the skills infrastructure domain.

Unicorn — A company founded after 2008 that has reached a valuation of over US$1 billion. For intents and purposes of this report, we use the term unicorn to refer to both private as well as public and acquired tech and venture capital–backed companies that have reached this valuation. Thus, for this report we use the term “Unicorn” to compare high-growth companies, often technology based, that have reached a valuation over US$1 billion, regardless of whether they are publicly (for example, stock exchange through an initial public offering [IPO], a special purpose acquisition company [SPAC], direct listing, or other means) or privately financed.

Venture capital (VC) — A form of private equity financing that is provided by venture capital firms or funds to start-up, early-stage, and emerging companies that have been deemed to have high growth potential or that have demonstrated high growth.

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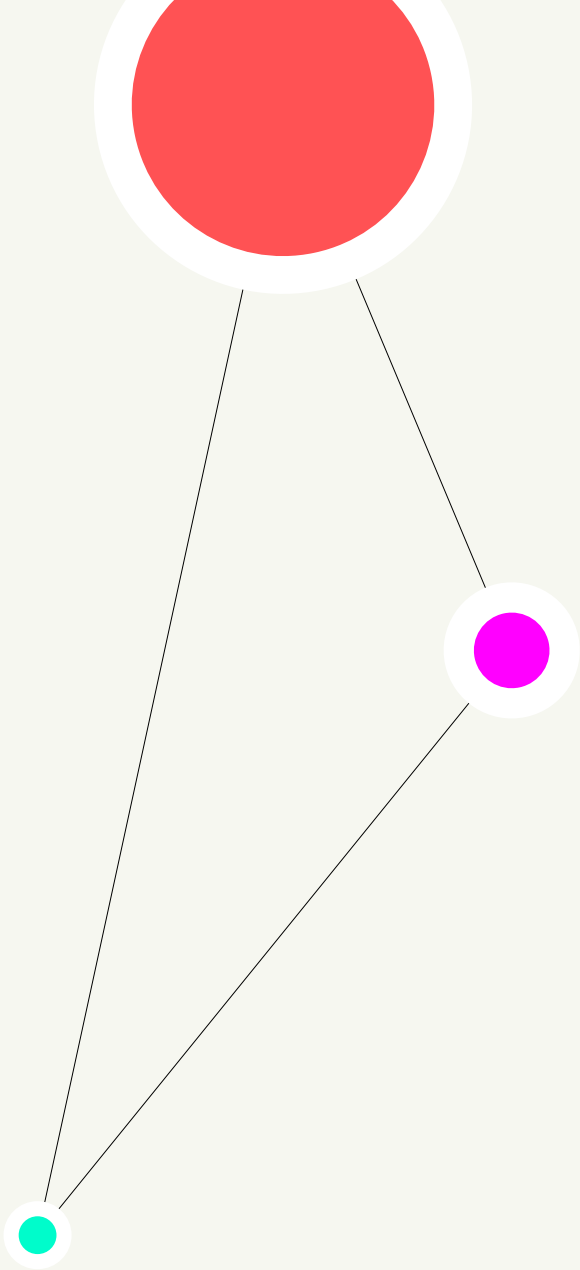

This report analyzes the start-up ecosystem in Tokyo and the greater surrounding area in Japan in the transition of the innovation model to a hybrid of traditional public sector-university-corporation research and development (R&D) combined with start-up agile innovation. It first introduces the role of a start-up ecosystem in contributing to the development of global cities, and thus to the wider national economy. It then takes a country-level view of Japan's innovation system, within which the metropolitan region operates, in the transition to the innovation-start-up ecosystem. This description is followed by an analysis of the specifics of the Tokyo start-up ecosystem — which consists of investment, support infrastructure, and skills infrastructure — factors that merit close inspection and deep analytics. And finally, the report ends with conclusions — what could be done better or differently to exploit opportunities within Tokyo — but also wider lessons for other global cities.

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